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**Draft Alaska Marine Mammal  
Stock Assessments 200345**

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## PREFACE

On April 30, 1994, Public Law 103-238 was enacted allowing significant changes to provisions within the Marine Mammal Protection Act (MMPA). Interactions between marine mammals and commercial fisheries are addressed under three new sections. This new regime replaced the interim exemption that has regulated fisheries-related incidental takes since 1988. Section 117, Stock Assessments, required the establishment of three regional scientific review groups to advise and report on the status of marine mammal stocks within Alaska waters, along the Pacific Coast (including Hawaii), and the Atlantic Coast (including the Gulf of Mexico). This report provides information on the marine mammal stocks of Alaska under the jurisdiction of the National Marine Fisheries Service.

Each stock assessment includes, when available, a description of the stock's geographic range, a minimum population estimate, current population trends, current and maximum net productivity rates, optimum sustainable population levels and allowable removal levels, and estimates of annual human-caused mortality and serious injury through interactions with commercial fisheries and subsistence hunters. These data will be used to evaluate the progress of each fishery towards achieving the MMPA's goal of zero fishery-related mortality and serious injury of marine mammals.

The Stock Assessment Reports should be considered working documents, as they are updated as new information becomes available. The Stock Assessment Reports were originally developed in 1995 (Small and DeMaster 1995). Revisions have been published for the following years: ~~This is a working document. This document represents the sixth revision since the original development of the stock assessment reports in 1995 (Small and DeMaster 1995). The first through fifth revisions were entitled the~~ 1996 (Hill et al. 1997), 1998 (Hill and DeMaster 1998), 1999 (Hill and DeMaster 1999), 2000 (Ferrero et al. 2000), and 2001 (Angliss et al. 2001), 2002 (Angliss and Lodge 2002), and 2003 (Angliss and Lodge 2002), Alaska Marine Mammal Stock Assessment Reports, respectively. Due to a lack of needed updates and delays in publication, there was no Alaska Marine Mammal Stock Assessment Report published for 2004; edits planned for 2004 will instead be augmented as necessary and published in this 2005 revision. Each stock assessment report is designed to stand alone and is updated as new information becomes available. The MMPA requires stock assessment reports to be reviewed annually for stocks designated as strategic, annually for stocks where there are significant new information available, and at least once every 3 years for all other stocks. New information for all strategic stocks (Steller sea lions, northern fur seals, Cook Inlet beluga whales, sperm whales, humpback whales, fin whales, North Pacific right whales, and bowhead whales), were reviewed in 2003 and late 2002/2004. This review, and a review of other stocks, led to the revision of the following stock assessments for the 2002/2005 document: Steller sea lion (western and eastern U.S. stocks), northern fur seal, spotted seal, bearded seal, ringed seal, ribbon seal, Cook Inlet-beluga whale (Cook Inlet, Beaufort Sea, eastern Bering Sea, Bristol Bay, and eastern Chukchi Sea), central and western stocks of humpback whales, fin whale, North Pacific right whale, killer whale (eastern North Pacific northern resident, eastern North Pacific transient, eastern North Pacific Alaska resident, and AT1 transient), gray whale, and bowhead whale. The stock assessment reports for all stocks, however, are included in this document to provide a complete reference. Those sections of each stock assessment report containing significant changes are listed in Appendix Table 1. The authors solicit any new information or comments which would improve future stock assessment reports.

The U. S. Fish and Wildlife Service (USFWS) has management authority for polar bears, sea otters and walrus. Copies of the stock assessments for these species are included in the NMFS Stock Assessment Reports for your convenience.

Ideas and comments from the Alaska Scientific Review Group (SRG) have significantly improved this document from its draft form. The authors wish to express their gratitude for the thorough reviews and helpful guidance provided by the Alaska Scientific Review Group members: Brendan Kelly (chair through 2004), Lloyd Lowry (chairman), Milo Adkison, Lance Barrett-Lennard, Ralph Anderson, John Gauvin, Sue Hills (chair from 2004 to present), Charlie Johnson, Brendan Kelly, Matt Kookesh, Denby Lloyd, Lloyd Lowry, Beth Mathews, Craig Matkin, Jan Straley, and Kate Wynne.

The information contained within the individual stock assessment reports stems from a variety of sources. Where feasible, we have attempted to utilize only published material. When citing information contained in this document, authors are reminded to cite the original publications, when possible.



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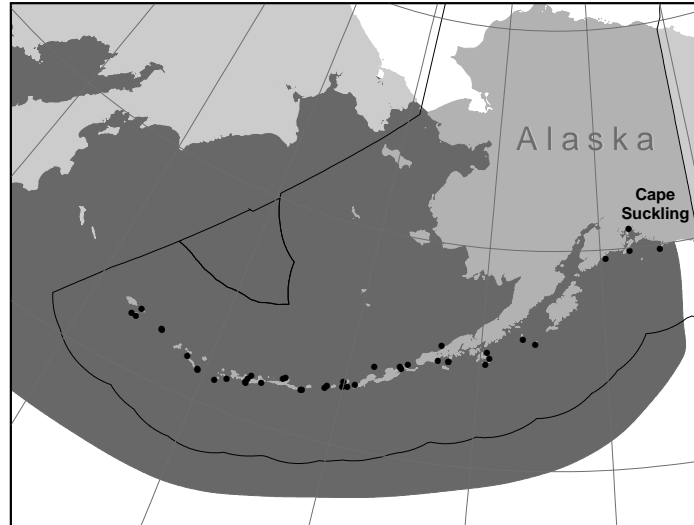
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## STELLER SEA LION (*Eumetopias jubatus*): Western U. S. Stock

### STOCK DEFINITION AND GEOGRAPHIC RANGE

Steller sea lions range along the North Pacific Rim from northern Japan to California (Loughlin et al. 1984), with centers of abundance and distribution in the Gulf of Alaska and Aleutian Islands, respectively. The species is not known to migrate, but individuals disperse widely outside of the breeding season (late May-early July), thus potentially intermixing with animals from other areas. Despite the wide ranging movements of juveniles and adult males in particular, exchange between rookeries by breeding adult females and males (other than between adjoining rookeries) appears low (NMFS 1995); ~~however, resighting data from branded animals have not yet been analyzed.~~

Loughlin (1997) considered the following information when classifying stock structure based on the phylogeographic approach of Dizon et al. (1992): 1) Distributional data: geographic distribution continuous, yet a high degree of natal site fidelity and low (<10%) exchange rate of breeding animals between rookeries; 2) Population response data: substantial differences in population dynamics (York et al. 1996); 3) Phenotypic data: unknown; and 4) Genotypic data: substantial differences in mitochondrial DNA (Bickham et al. 1996). Based on this information, two separate stocks of Steller sea lions are now recognized within U. S. waters: an eastern U. S. stock, which includes animals east of Cape Suckling, Alaska (144°W), and a western U. S. stock, which includes animals at and west of Cape Suckling (Loughlin 1997, Fig. 1).



**Figure 1.** Approximate distribution of Steller sea lions in the eastern North Pacific (shaded area). Major haulouts and rookeries are also depicted (points).

### POPULATION SIZE

The most recent comprehensive estimate (pups and non-pups) of abundance of the western stock of Steller sea lions in Alaska is based on aerial surveys of non-pups in June ~~2002~~ 2004 and ground-based pup counts in June and July of 2001-2004 (NMML, unpublished data), and 2002 (Sease and Gudmundson 2002). Data from these surveys represent actual counts of pups and non-pups at all rookeries and major haulout sites. During the ~~2002~~ 2004 aerial survey, a total of ~~26,602~~ 29,037 non-pups were counted at ~~259~~ 262 rookeries and haul-out sites; ~~13,010~~ 13,892 in the Gulf of Alaska and ~~13,592~~ 15,145 in the Bering Sea/Aleutian Islands (Sease and Gudmundson 2002) (NMML, unpublished data). A composite pup count for 2001-2004 and 2002 includes counts from 2 sites in 2001, ~~24~~ 14 sites in 2002, 16 sites in 2003 and 18 sites in 2004, and from seven sites in 2001. There were ~~3,727~~ 4,192 pups counted in the Gulf of Alaska and ~~5,284~~ 4,450 pups counted in the Bering Sea/Aleutian Islands for a total of ~~8,177~~ 9,476 for the stock. Combining the pup count data from 2001-2004 (9,476) to 2002 (8,177) and non-pup count data from ~~2002 (26,602)~~ 2004 (29,037) results in a minimum abundance estimate of ~~34,779~~ 38,513 Steller sea lions in the western U.S. stock in 2001-2002 4.

Steller sea lions in Russia are, at this time, part of the western stock. However, estimates of the abundance are not provided for the Russian portion of the stock because preliminary results of genetics data indicates that the Russian animals may constitute a separate stock and because the counting methods are not consistently employed in both Alaska and Russia.

The 4.5 multiplier (4.5 times the best estimate of pup production) used for estimating the size of the eastern stock of Steller sea lions is not appropriate for use in estimating the abundance of the western stock. The 4.5 multiplier is based on a life history table using age-specific fecundity and survival for a stable population. Clearly, because the western stock has declined drastically, the assumption of a stable population is not valid. In addition,

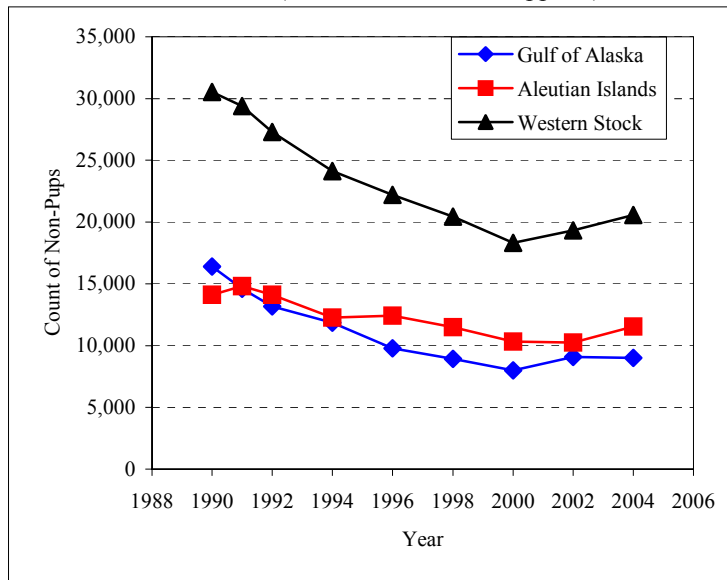
the use of the 4.5 multiplier assumes that pup counts are readily available; however, pup counts are only conducted in the Central and Western Aleutians every 4-5 years.

### Minimum Population Estimate

The ~~2002~~ 2004 count of non-pups (~~26,602~~) (29,037) plus the number of pups in 2001-~~2002~~ (~~8,177~~) 2004 (9,476) is 38,513 ~~34,779~~, which will be used as the minimum population estimate ( $N_{MIN}$ ) for the western U. S. stock of Steller sea lion (Wade and Angliss 1997). This is considered a minimum estimate because it has not been corrected to account for animals ~~which~~ ~~that~~ were at sea during the surveys.

### Current Population Trend

The first reported trend counts (an index to examine population trends) of Steller sea lions in Alaska were made in 1956-60. Those counts indicated that there were at least 140,000 (no correction factors applied) sea lions in the Gulf of Alaska and Aleutian Islands (Merrick et al. 1987). Subsequent surveys indicated a major population decrease, first detected in the eastern Aleutian Islands in the mid-1970s (Braham et al. 1980). Counts from 1976 to 1979 indicated about 110,000 sea lions (no correction factors applied, Table 1). The decline appears to have spread eastward to the Kodiak Island area during the late 1970s and early 1980s, and then westward to the central and western Aleutian Islands during the early and mid-1980s (Merrick et al. 1987, Byrd 1989). The greatest declines since the 1970s occurred in the eastern Aleutian Islands and western Gulf of Alaska, but declines also occurred in the central Gulf of Alaska and central Aleutian Islands. ~~More recently,~~



**Figure 2.** Counts of adult and juvenile Steller sea lions at rookery and haulout trend sites throughout the range of the western U.S. stock, 1990-2004. Correction factor applied to 2004 count for film format differences (Fritz and Stinchcomb in press).

~~Counts of Steller sea lions at trend sites for the western U. S. stock decreased 40% from 1990 to 2000 (Table 1). Counts at trend sites during 2000 indicate that the number of sea lions in the Bering Sea/Aleutian Islands region has declined 10.2% between 1998 and 2000. From 1991-00, an average annual decline of 5.4% in non-pup counts at trend sites was reported by (Loughlin and York 2000).~~

Most Recently, counts of non-pup Steller sea lions at trend sites for the western U.S. stock increased 5.5% from 2000 to 2002, and at a similar rate between 2002 and 2004 (Table 1, Fig. 2). These were ~~is was~~ the first region-wide increases for the western stock since standardized surveys began in the 1970s. However, the 2002 count was still 57.4% below the 1990 count and 36.7% 32.6% below the 1990 count. ~~The count for trend sites in the Gulf of Alaska increased 13.7% from 2000 to 2002, whereas those in the Aleutian Islands showed equivocal change (down 0.8%). The long-term, average decline for 1990-024 is 4.3% 3.1% per year (NMML unpublished data).~~

**Table 1.** Counts of adult and juvenile Steller sea lions observed at rookery and haulout trend sites by year and geographical area for the western U. S. stock from the late 1970s through 1998 (NMFS 1995, Sease et al. 2001, NMML unpublished data). Counts from 1976 to 1979 (NMFS 1995) were combined to produce complete regional counts that are comparable to the 1990-024 data. The asterisk identifies 637 non-pups counted at six trend sites in 1999 in the eastern Gulf of Alaska which were not surveyed in 1998. 2004 data reflect a 3.5% reduction from actual counts to account for differences in survey protocol in 2004 relative to previous years. Actual 2004 trend site counts were: Gulf of Alaska – 9,332; Bering Sea/Aleutian Islands – 11,977; Total – 21,309.

Area	late 1970s	1990	1991	1992	1994	1996	1998	2000	2002	2004
Gulf of Alaska	65,296	16,409	14,598	13,193	11,862	9,784	8,937*	7,995	9,097	9,005
Bering Sea/Aleutians	44,584	14,116	14,807	14,106	12,274	12,426	11,501	10,330	10,250	11,558
Total	109,880	30,525	29,405	27,299	24,136	22,210	20,438*	18,325	19,347	20,563

## CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

There are no estimates of maximum net productivity rate for Steller sea lions. Hence, until additional data become available, it is recommended that the theoretical maximum net productivity rate ( $R_{MAX}$ ) for pinnipeds of 12% be employed for this stock (Wade and Angliss 1997).

## POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 reauthorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor:  $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$ . However, it should be noted that the PBR management approach was developed with the understanding that direct human-related mortalities would be the primary reason for observed declines in abundance for marine mammal stocks in U. S. waters. For at least this stock, this assumption seems unwarranted. The recovery factor ( $F_R$ ) for this stock is 0.1, the default value for stocks listed as “endangered” under the Endangered Species Act (Wade and Angliss 1997). Thus, for the western U. S. stock of Steller sea lions,  $PBR = 209,231$  animals ( $34,779 \times 38,513 \times 0.06 \times 0.1$ ).

## ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

### Fisheries Information

Until 2003, there were six different federally-regulated commercial fisheries in Alaska that could have interacted with Steller sea lions. These fisheries were monitored for incidental mortality by fishery observers. As of 2003, changes in fishery definitions in the List of Fisheries has resulted in separating these six fisheries into 22 fisheries (69 FR 70094, 2 December 2004). This change does not represent a change in fishing effort, but provides managers with better information on the component of each fishery that is responsible for the incidental serious injury or mortality of marine mammal stocks in Alaska. Six different commercial fisheries operating within the range of the western U. S. stock of Steller sea lions were monitored for incidental take by fishery observers during 1990-99: Bering Sea (and Aleutian Islands) groundfish trawl, longline, and pot fisheries, and Gulf of Alaska groundfish trawl, longline, and pot fisheries. No sea lion mortality was observed by fishery observers in either pot fishery since 1990, nor in the BSAI longline fisheries during the past 5 years. For the fisheries with observed takes, the range of observer coverage over the 9-year period, as well as the annual observed and estimated mortalities, are presented in Table 2a. The mean annual (total) mortality for the most recent 5-year period was 9.6 (CV = 0.10) for the Bering Sea groundfish trawl fishery, 0.6 (CV = 0.6) for the Gulf of Alaska groundfish trawl fishery, and 1.2 (CV = 0.9) for the Gulf of Alaska groundfish longline fishery. In 1996 (66% observer coverage), only 2 of the 4 observed mortalities in the Bering Sea trawl fishery occurred during monitored hauls, leading to an underestimate (3) of the extrapolated mortality for that fishery. As a result, 4 mortalities were used as both the observed and estimated mortalities for that year (Table 2a). The observed mortality in the 1993 Bering Sea longline fishery (30% observer coverage) also occurred during an unmonitored haul and therefore could not be used to estimate mortality for the entire fishery. Therefore, 1 mortality was used as both the observed mortality and estimated mortality in 1993 for that fishery, and should be considered a minimum estimate. Between 1999-2003, there were incidental serious injuries and mortalities of western Steller sea lions in the following fisheries: Bering Sea/Aleutian Islands Atka mackerel trawl, Bering Sea/Aleutian Islands flatfish trawl, Bering Sea/Aleutian Islands Pacific cod trawl, Gulf



of Alaska Pacific cod trawl, Gulf of Alaska pollock trawl, Bering Sea/Aleutian Islands Pacific cod longline, and Gulf of Alaska sablefish longline (Table 2).

Observers also monitored the Prince William Sound salmon drift gillnet fishery in 1990 and 1991, recording 2 mortalities in 1991, extrapolated to 29 (95% CI 1-108) kills for the entire fishery (Wynne et al. 1992). No mortalities were observed during 1990 for this fishery (Wynne et al. 1991), resulting in a mean kill rate of 14.5 (CV = 1.0) animals per year for 1990 and 1991. In 1990, observers boarded 300 (57.3%) of the 524 vessels that fished in the Prince William Sound salmon drift gillnet fishery, monitoring a total of 3,166 sets, or roughly 4% of the estimated number of sets made by the fleet. In 1991, observers boarded 531 (86.9%) of the 611 registered vessels and monitored a total of 5,875 sets, or roughly 5% of the estimated sets made by the fleet (Wynne et al. 1992). The Alaska Peninsula and Aleutian Islands salmon drift gillnet fishery was also monitored during 1990 (roughly 4% observer coverage) and no Steller sea lion mortalities were observed. It is not known whether these incidental mortality levels are representative of the current incidental mortality levels in these fisheries.

An observer program for the Cook Inlet salmon set and drift gillnet fisheries was implemented in 1999 and 2000, in response to the concern that there may be significant numbers of marine mammal injuries and mortalities that occur incidental to these fisheries. Observer coverage in the Cook Inlet drift gillnet fishery was 1.75% and 3.73% in 1999 and 2000, respectively. The observer coverage in the Cook Inlet set gillnet fishery was 7.3% and 8.3% in 1999 and 2000, respectively (Manly in review). The observer coverage during both years was approximately 2.5%; precise coverage figures will be available when the contract report is provided to NMFS in 2001. There were no mortalities of marine mammals Steller sea lions observed in the set or drift gillnet fisheries in either 1999 or 2000 (Manly in review). Because information from observer programs is substantially more reliable than information from self-reported data, NMFS has removed the reference to self-reported data for these fisheries from Table 2b3 and will rely on the 1999-2000 observer program data as an accurate reflection of the level of Steller sea lion mortality in this fishery. An observer program conducted for a portion of the Kodiak drift gillnet fishery in 2002 did not observe any serious injuries or mortalities of Steller sea lions, although Steller sea lions were frequently observed in the vicinity of the gear (Manly et al. in review).

Combining the mortality estimates from the Bering Sea and Gulf of Alaska groundfish trawl and Gulf of Alaska longline fisheries presented above ( $9.6 + 0.6 + 1.2 = 11.4$ ) (10.6) with the mortality estimate from the Prince William Sound salmon drift gillnet fishery (14.5) results in an estimated mean annual mortality rate in the observed fisheries of 25.91 (CV = 0.658) sea lions per year from this stock.

**Table 2a.** Summary of incidental mortality of Steller sea lions (western U. S. stock) due to commercial fisheries from 1990 through 20043 and calculation of the mean annual mortality rate. Mean annual mortality in brackets represents a minimum estimate from self-reported fisheries information. Data from 19979 to 20043 (or the most recent 5 years of available data) are used in the mortality calculation when more than 5 years of data are provided for a particular fishery. n/a indicates that data are not available. \* Data from the 1999 Cook Inlet observer program are preliminary.

Fishery name	Years	Data type	Range of observer coverage	Observed mortality (in given yrs.)	Estimated mortality (in given yrs.)	Mean annual mortality
Bering Sea/Aleutian Is. (BSAI) groundfish trawl	97-01	obs data	62%	6, 6 8 6 7	10, 9 9 7 11	9.6 (CV = 0.10)
Bering Sea/Aleutian Is. Atka mackerel trawl	1999 2000 2001 2002 2003	obs data	77.2 86.3 82.4 N/A 95.4	3 1 1 0 1	4 1 1 0 1	1.51 (CV = 0.19)
Bering Sea/Aleutian Is. flatfish trawl	1999 2000 2001 2002 2003	obs data	66.3 64.5 57.6 58.4 63.9	1 3 4 1 1	1 4 6 2 1	3.35 (CV = 0.17)

Fishery name	Years	Data type	Range of observer coverage	Observed mortality (in given yrs.)	Estimated mortality (in given yrs.)	Mean annual mortality
Bering Sea/Aleutian Is. (BSAI) groundfish trawl	97-01	obs data	62%	6, 6 8 6 7	10, 9 9 7 11	9.6 (CV = 0.10)
Bering Sea/Aleutian Is. Pacific cod trawl	1999 2000 2001 2002 2003	obs data	50.6 N/A N/A N/A 49.9	1 0 0 0 2	1 0 0 0 4	1.09 (CV = 0.58)
Bering Sea/Aleutian Is. pollock trawl	1999 2000 2001 2002 2003	obs data	75.2 76.2 79.0 80.0 N/A	2 2 2 3 0	3 4 3 3 0	2.51 (CV = 0.13)
Gulf of Alaska (GOA) groundfish trawl	96-00	obs data	33-55%	0, 0 1 0 0	0, 0 3 0 0	0.6 (CV = 0.6)
Gulf of Alaska Pacific cod trawl	1999 2000 2001 2002 2003	obs data	N/A N/A 20.3 N/A N/A	0 0 1 0 0	0 0 5 0 0	0.94 (CV = 0.83)
Gulf of Alaska pollock trawl	1999 2000 2001 2002 2003	obs data	N/A N/A N/A N/A 31.4	0 0 0 0 1	0 0 0 0 2	0.48 (CV = 0.96)
GOA groundfish longline (incl. misc. finfish and sablefish fisheries)	97-01	obs data	11-14%	0, 0, 0, 1, 0	0, 0, 0, 6, 0	1.2 (CV = 0.9)
Bering Sea/Aleutian Is. Pacific cod longline	1999 2000 2001 2002 2003	obs data	N/A N/A N/A 29.6 N/A	0 0 0 1 0	0 0 0 4 0	0.74 (CV = 0.86)
Prince William Sound salmon drift gillnet	90-91	obs data	4-5%	0, 2	0, 29	14.5 (CV = 1.0)
Prince William Sound salmon set gillnet	90	obs data	3%	0	0	0
Alaska Peninsula/Aleutian Islands salmon drift gillnet	90	obs data	4%	0	0	0
Cook Inlet salmon set gillnet*	99-00	obs data	2-5%	0, 0	0, 0	0

Fishery name	Years	Data type	Range of observer coverage	Observed mortality (in given yrs.)	Estimated mortality (in given yrs.)	Mean annual mortality
<del>Bering Sea/Aleutian Is.</del> (BSAI) groundfish trawl	97-01	obs data	62%	6, 6 8 6 7	10, 9 9 7 11	9.6 (CV = 0.10)
Cook Inlet salmon drift gillnet*	99-00	obs data	2-5%	0, 0	0, 0	0
Observer program total						25.925.1 (CV = 0.640.58)
				<b>Reported mortalities</b>		
Alaska Peninsula/Aleutian Islands salmon set gillnet	90-0103	self reports	n/a	0, 1, 1, 1, n/a n/a, n/a, n/a, n/a, n/a, n/a 1994-03: n/a	n/a	[0.75]
Bristol Bay salmon drift gillnet	90-0103	self reports	n/a	0, 4, 2, 8, n/a n/a, n/a, n/a, n/a, n/a, n/a 1994-03: n/a	n/a	[3.5]
Prince William Sound set gillnet	90-0103	self reports	n/a	0, 0, 2, 0, n/a n/a, n/a, n/a, n/a, n/a, n/a 1994-03: n/a	n/a	[0.5]
Alaska miscellaneous finfish set gillnet	90-0103	self reports	n/a	0, 1, 0, 0, n/a n/a, n/a, n/a, n/a, n/a, n/a 1994-03: n/a	n/a	[0.25]
Alaska halibut longline (state and federal waters)	90-0103	self reports	n/a	0, 0, 0, 0, 1 n/a n/a, n/a, n/a, n/a, n/a, n/a 1995-03: n/a	n/a	[0.2]
Alaska sport salmon troll (non-commercial)	93-0103	strand	n/a	0, 0, 0, 0, 1, 0, n/a, n/a, n/a, 1, n/a	n/a	[0.2]
Miscellaneous fishing gear	1999-03	strand	n/a	n/a, n/a, n/a, n/a, 1	n/a	[0.2]
Minimum total annual mortality						31.530.7 (CV = 0.640.58)

An additional source of information on the number of Steller sea lions killed or injured incidental to commercial fishing operations is the self-reported fisheries information required of vessel operators by the MMPA. Some incidental takes of sea lions reported in the Gulf of Alaska fisheries were listed as "unknown species", indicating the animals could have been either Steller or California sea lions. Based on all logbook reports for both species within the Gulf of Alaska, California sea lions represented only 2.2% of all interactions. Thus, the reports of injured and killed "unknown" sea lions were considered to be Steller sea lions. During the period between 1990 and 20012003, fisher self-reports from 6 unobserved fisheries (see Table 2a) resulted in an annual mean of 5.4 mortalities from interactions with commercial fishing gear. However, because logbook records (fisher self-reports required during 1990-94) are most likely negatively biased (Credle et al. 1994), these are considered to be minimum estimates. These totals are based on all available self-reports for Alaska fisheries, except the groundfish trawl and

longline fisheries in the Bering Sea, Aleutian Islands, and Gulf of Alaska, and the Prince William Sound salmon drift gillnet fishery for which observer data were presented above. The Bristol Bay salmon drift gillnet and set gillnet fisheries accounted for the majority of the reported incidental take in unobserved fisheries. Logbook data are available for part of 1989-1994, after which incidental mortality reporting requirements were modified. Under the new system, logbooks are no longer required; instead, fishers provide self-reports. Data for the 1994-95 phase-in period is fragmentary. After 1995, the level of reporting dropped dramatically, such that the records are considered incomplete and estimates of mortality based on them represent minimums (see Appendix 7 for details).

**Strandings**—Reports from the NMFS stranding database of Steller sea lions entangled in fishing gear or with injuries caused by interactions with gear are another source of mortality data. During the 5-year period from 1997 to 2000, there was only one confirmed fishery-related Steller sea lion stranding in the range of the western stock. This sighting involved an animal at Round Island with netting or rope around its neck; no more specific information is available on the type of fishing gear involved. the only fishery-related Steller sea lion (western stock) stranding was reported in 1998 in Whittier; the animal was entangled in a large flasher/spoon, but the incident is not considered a serious injury. August of 1997 in Prince William Sound. The animal had troll gear in its mouth and down its throat (considered a serious injury; see Angliss and DeMaster 1998). In addition to this incident, a Steller sea lion was entangled in a large flasher/spoon in 1998. It is likely that this mortality injury occurred as a result of a sport fishery, not a commercial fishery (Table 2a). There are sport fisheries for both salmon and shark in this area; there is no way to distinguish between them since both fisheries use a similar type of gear (J. Gauvin, Groundfish Forum, Inc., pers. comm.). There was evidence of incidental fishery interactions with two stranded Steller sea lions in 1998; there have been no such incidences in stranding records from 1999 to 2002. Additional information on the nature of the fishery interactions is not currently available. Fishery-related strandings during 1997-01, 1999-03 result in an estimated annual mortality of 0.2 animals from this stock. This estimate is considered a minimum because not all entangled animals strand and not all stranded animals are found or reported. Steller sea lions reported in the stranding database as shot are not included in this estimate, as they likely may result from animals struck and lost in the Alaska Native subsistence harvest.

NMFS studies using satellite tracking devices attached to Steller sea lions suggest that they rarely go beyond the U.S. Exclusive Economic Zone into international waters. Given that the high-seas gillnet fisheries have been prohibited and other net fisheries in international waters are minimal, the probability that Steller sea lions are taken incidentally in commercial fisheries in international waters is very low. NMFS concludes that the number of Steller sea lions taken incidental to commercial fisheries in international waters is insignificant.

The minimum estimated mortality rate incidental to commercial fisheries is 4-5 <sup>30.7</sup> sea lions per year, based on observer data (25-9 <sup>25.1</sup>) and self-reported fisheries information (5.46) or stranding data (0.2) where observer data were not available. No observers have been assigned to several fisheries that are known to interact with this stock (self-reported data from these fisheries are provided in Table 2a), making the estimated mortality a minimum estimate.

### Subsistence/Native Harvest Information

The 1992-96 <sup>2000-03</sup> subsistence harvest of Steller sea lions in Alaska was estimated by the Alaska Department of Fish and Game, under contract with the NMFS (Table 2b; Wolfe and Mishler 1993, 1994, 1995, 1996, 1997; Wolfe and Hutchinson-Scarborough 1999; Wolfe et al. 2002; J. Fall, ADF&G, pers. comm.). In each year, data were collected through systematic interviews with hunters and users of marine mammals in approximately 2,100 households in about 60 coastal communities within the geographic range of the Steller sea lion in Alaska. The great majority (approximately 99%) of the statewide subsistence take was from the western U. S. stock and the majority (79%) of this take was by Aleut hunters in the Aleutian and Pribilof Islands. Real-time monitoring of Steller sea lion harvest involves monitoring of harvest information directly after the harvest, and occurs on one of the Pribilof Islands, St. Paul Island. Results are summarized and reported annually (Lestenkof et al. 2003, Zavadil et al. 2003, Zavadil et al. 2004), and are used as the source of the Steller sea lion subsistence harvest estimates in the annual ADF&G report (e.g., Wolfe et al. 2004). Approximately 43 of the interviewed communities lie within the range of the western U. S. stock. The majority (79%) of sea lions were taken by Aleut hunters in the Aleutian and Pribilof Islands. A summary of the subsistence harvest of Steller sea lions from the western U. S. stock are provided in Table 2b. The great majority (approximately 99%) of the statewide subsistence take was from the western U. S. stock. The mean annual subsistence take from this stock over the 4-year period from 2000-03, excluding the harvest on St. Paul Island, was 176 <sup>162.5</sup> sea lions, and the mean annual subsistence take from this stock on St. Paul Island during this period was 25.3 sea lions per year (Zavadil et al. 2004), for a total mean subsistence harvest of 187.8 Steller sea lions/year. The reported average age composition of the harvest in 2001 was 42% adults, 39%

juveniles, 1% pups, and 18% unknown age. The reported average sex composition of the harvest was approximately 58% males, 19% females, and 22% of unknown sex.

### Other Mortality

Illegal shooting of sea lions was thought to be a potentially significant source of mortality prior to the listing of sea lions as “threatened” under the U.S. Endangered Species Act (ESA) in 1990. Such shooting has been illegal since the species was listed as threatened. (Note: the 1994 Amendments to the MMPA made intentional lethal take of any marine mammal illegal except for subsistence take by Alaska Natives or where imminently necessary to protect human life). Records from NMFS enforcement indicate that there were 2 cases of illegal shootings of Steller sea lions in the Kodiak area in 1998, both of which were successfully prosecuted (NMFS, Alaska Enforcement Division). There have been no cases of successfully prosecuted illegal shootings between 1999 and 2002<sup>3</sup> (NMFS, Alaska Enforcement Division).

**Table 2b3.** Summary of the subsistence harvest data for the western U. S. stock of Steller sea lions, 1992-01-2000-03. Brackets indicate that the 1996 data remain in dispute and the 1997 data are preliminary. Subsistence harvest data were not collected in 1999 and 2002 data are preliminary report should be available by mid-December. Sources: Wolfe et al. 2002, Wolfe et al. 2003, Zavadil et al. 2004.

Year	Estimated total number taken	95% confidence interval	Number harvested	Number struck and lost
1992	549	452-712	370	179
1993	487	390-629	348	139
1994	416	330-554	336	80
1995	339	258-465	307	32
1996	[179]	[158-219]	[149]	[30]
1997	[164]	[129-227]	[146]	[18]
1998	178	137-257	131	47
2000	164	121-244	141	22
2001	198	162-282	156	42
2002	185	not calculated	144	41
2003	205	149-303	163	42
Mean annual take 1997-01-2000-03	176 188			

### STATUS OF STOCK

The current annual level of incidental mortality (31.5<sup>30.7</sup>) exceeds 10% of the PBR (24<sup>23</sup>) and, therefore, cannot be considered insignificant and approaching a zero mortality and serious injury rate. Based on available data, the estimated annual level of total human-caused mortality and serious injury (31.5<sup>30.7</sup> + 176<sup>188</sup> = 208<sup>218.7</sup>) is below the PBR level (24<sup>231</sup>) for this stock. The western U. S. stock of Steller sea lion is also currently listed as “endangered” under the ESA, and therefore designated as “depleted” under the MMPA. As a result, the stock is classified as a strategic stock. However, given that the population is declining for unknown reasons that are not explained by the level of direct human-caused mortality, there is no guarantee that limiting those mortalities to the level of the PBR will reverse the decline.

A number of management actions have been were implemented between since 1990 and 1998 to promote the recovery of the western U. S. stock of Steller sea lions, including 3 nautical mile (nmi) no-entry zones around rookeries, prohibition of groundfish trawling within 10-20 nmi of certain rookeries, and spatial and temporal allocation of Gulf of Alaska pollock and Aleutian Island Atka mackerel total allowable catch. More Recent modifications began in 1999 and continued into finalized in 2002; involve a complex set of regulations that changed the temporal and spatial distribution of the pollock, Pacific cod and Atka mackerel fisheries throughout the range of the western stock in U.S waters. These measures were reviewed by NMFS (2003). including reductions in removals of Atka mackerel within areas designated as critical habitat in the central and western Aleutian Islands, greater temporal dispersion of the Atka mackerel harvest, further temporal and spatial dispersal of the Bering Sea and Gulf of Alaska pollock and cod fisheries, closure of the Aleutian Islands to pollock trawling, and expansion of the number and extent of buffer zones around sea lion rookeries and haulouts.

## Habitat Concerns

The unprecedented decline in the western U. S. stock of Steller sea lion caused a change in the listing status of the stock from “threatened” to “endangered” under the U. S. Endangered Species Act of 1973. ~~There is currently no sign that the population decline since 1990 has slowed or stopped.~~ Survey data collected since 2000 suggest that the decline has slowed or stopped in most of the range of the western U. S. stock. Many theories factors have been suggested as causes of the decline, (e.g., overfishing, environmental change, disease, killer whale predation, etc.) but it is not clear ~~what factor or factors~~ which single or combination of factors are most important in causing the decline. However, nutritional stress related to competition ~~for food, perhaps in conjunction~~ with commercial fisheries is a hypothesis currently receiving serious attention.

NMFS developed a Biological Opinion (BO) on the groundfish fisheries in the Bering Sea/Aleutian Islands and Gulf of Alaska regions in 2000. In this BO, NMFS determined that the continued prosecution of the groundfish fisheries as described in the Fishery Management Plan for Bering Sea/Aleutian Islands Groundfish and in the Fishery Management Plan for Gulf of Alaska Groundfish is likely to jeopardize the continued existence of the western population of Steller sea lion and to adversely modify critical habitat. NMFS also identified several other factors that could contribute to the decline of the population, including a shift in a large-scale weather regime and predation. To avoid jeopardy, NMFS identified a Reasonable and Prudent Alternative that included components such as 1) adoption of a more precautionary rule for setting “global” harvest limits, 2) extension of 3 nmi protective zones around rookeries and haulouts not currently protected, 3) closures of many areas around rookeries and haulouts to 20 nmi, 4) establishment of 4 seasonal catch limits inside critical habitat and two seasonal releases outside of critical habitat, and 5) establishment of a procedure for setting limits on removal levels in critical habitat based on the biomass of target species in critical habitat.

NMFS completed a draft Supplemental Environmental Impact Statement (SEIS) in September 2000 for the groundfish fisheries in the Bering Sea Aleutian Islands and the Gulf of Alaska. Based on the potential for indirect interactions between the groundfish fisheries and Steller sea lions, northern fur seals, and harbor seals, NMFS determined that the current practices involved in the management of the groundfish fishery in Alaska “may have adverse impacts on the western U. S. stock of Steller sea lions, northern fur seals in the Bering Sea, and both the GOA and western stocks of harbor seals”. However, the SEIS was determined to be incomplete in a Federal District Court ruling and remanded back to NMFS for further development.

In 2001, NMFS developed ~~a new~~ another SEIS to consider the impacts on Steller sea lions of different management regimes for the Alaska groundfish fisheries. A committee composed of 21 members from fishing groups, processor groups, Alaska communities, environmental advocacy groups, and NMFS representatives met to recommend conservation measures for Steller sea lions and to develop a “preferred alternative” for the SEIS. Although consensus was not reached, a “preferred alternative” was identified and included in the SEIS. The preferred alternative included complicated, area-specific management measures (e.g., area restrictions and closures) designed to reduce direct and indirect interactions between the groundfish fisheries and Steller sea lions, particularly in waters within 10 nmi of haulouts and rookeries. The suite of conservation measures actually implemented in 2002 were developed after working with the: 1) State of Alaska to explore whether there are potential adverse effects of state fisheries on Steller sea lions, and 2) the North Pacific Fishery Management Council to further minimize overcapitalization of fisheries and concentration of fisheries in time and space. In addition, NMFS has agreed to revise the existing recovery plan for Steller sea lions, and is working towards the development of a co-management agreement with Alaska Native organizations for subsistence harvest of the western stock of Steller sea lions.

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## STELLER SEA LION (*Eumetopias jubatus*): Eastern U. S. Stock

### STOCK DEFINITION AND GEOGRAPHIC RANGE

Steller sea lions range along the North Pacific Rim from northern Japan to California (Loughlin et al. 1984), with centers of abundance and distribution in the Gulf of Alaska and Aleutian Islands, respectively. The species is not known to migrate, but individuals disperse widely outside of the breeding season (late May-early July), thus potentially intermixing with animals from other areas. Despite the wide ranging movements of juveniles and adult males in particular, exchange between rookeries by breeding adult females and males (other than between adjoining rookeries) appears low (NMFS 1995); ~~however, resighting data from branded animals have not yet been analyzed.~~

Loughlin (1997) considered the following information when classifying stock structure based upon the phylogeographic approach of Dizon et al. (1992): 1) Distributional data: geographic distribution continuous, yet a high degree of natal site fidelity and low (<10%) exchange rate of breeding animals between rookeries; 2) Population response data: substantial differences in population dynamics (York et al. 1996); 3) Phenotypic data: unknown; and 4) Genotypic data: substantial differences in mitochondrial DNA (Bickham et al. 1996). Based on this information, two separate stocks of Steller sea lions are now recognized within U. S. waters: an eastern U. S. stock, which includes animals east of Cape Suckling, Alaska (144°W), and a western U. S. stock, which includes animals at and west of Cape Suckling (Loughlin 1997, Fig. 3).



**Figure 23.** Approximate distribution of Steller sea lions in the eastern U.S. stock (shaded area). Major haulout and rookeries are also depicted (points). Note: Haulouts and rookeries in British Columbia are not shown.

### POPULATION SIZE

~~The previous estimate of Steller sea lion abundance in Southeast Alaska was based on comprehensive aerial surveys performed in June 1996 (Sease et al. 1999, Sease and Loughlin 1999). Data from these surveys represent actual counts of pups and non pups at all rookeries and major haulout sites in Southeast Alaska. In 1996 a total of 14,621 Steller sea lions were counted in Southeast Alaska, including 10,907 non pups and 3,714 pups. Aerial surveys in 1998 and 2000 included the trend sites and other major sites. There were some differences between which major sites were surveyed in 1998 and 2000, so the total counts for each survey are not entirely comparable. The counts for 1998 and 2000 were 10,939 and 12,417, respectively (Sease and Loughlin, 1999, Sease et al. 2001). Pup counts totaled 4,160 in 1997 and 4,257 in 1998 (Sease and Loughlin, 1999). The total count for Southeast Alaska in 1998 is 15,196 (10,939 non pups plus 4,257 pups); if we assume that the pup count is roughly stable, the total count for 2000 would be 16,674 (12,417 non pups plus 4,257 pups).~~

~~Aerial surveys and ground counts of California, Oregon, and Washington rookeries and major haulout sites were also conducted during the summer of 1996 (NMFS unpubl. data, National Marine Mammal Laboratory, 7600 Sand Point Way NE, Seattle, WA 98115; Southwest Fisheries Science Center, P. O. Box 271, La Jolla, CA 90238; ODF&W unpubl. data, Marine Science Drive, Newport, OR 97365). In 1996 a total of 6,555 Steller sea lions were counted in California (2,042), Oregon (3,990), and Washington (523), including 5,464 non pups and 1,091 pups.~~

~~The eastern U. S. stock of Steller sea lions is a transboundary stock, including sea lions from British Columbia rookeries (see Wade and Angliss 1997 for discussion of transboundary stocks). Aerial surveys were last conducted in British Columbia during 1994 and produced counts of 8,091 non pups and 1,186 pups, for a total count of 9,277 (Dept. Fisheries and Oceans, unpubl. data, Pacific Biological Station, Nanaimo, BC, V9R 5K6). Complete count data are not available for British Columbia in 1996. However, because the number of Steller sea lions in~~

British Columbia is thought to have increased since 1994 (P. Olesiuk, pers. comm., Pacific Biological Station, Canada), the 1994 counts represent a conservative estimate for the 1996 counts. Combining the total counts for the three regions results in a minimum estimated abundance of 31,028 (15,196 + 6,555 + 9,277) Steller sea lions in this stock.

— Slight changes in the non-pup numbers result from changes in the non-pup count database which occurred since publication of the results from the 1998 aerial survey (Sease and Loughlin 1999). The database underwent considerable review, verification, and editing; the most significant changes related to replicate counts of individual sites. For additional information on the minor changes in the non-pup numbers, see Sease et al. (2001).

— The abundance estimate for the eastern U. S. stock is based on counts of all animals (pup and non-pup) at all sites and has not corrected for animals missed because they were at sea. A reliable correction factor to account for these animals is currently not available (J. Sease, pers. comm., National Marine Fisheries Service). As a result, this represents an underestimate for the total abundance of Steller sea lions in this stock.

The eastern stock of Steller sea lions breeds on rookeries located in southeast Alaska, British Columbia, Oregon, and California; there are no rookeries located in Washington. Counts of pups on rookeries conducted near the end of the birthing season are nearly complete counts of pup production. Calkins and Pitcher (1982) concluded that the total Steller sea lion population could be estimated by multiplying the pup counts by a factor of 4.5, which was based on the birth rate, and the sex and age structure of the western Steller sea lion population in the central Gulf of Alaska. Using the most recent (2002) pup counts from aerial surveys from across the range of the eastern stock, the total population of the eastern stock of Steller sea lions is estimated to be 44,996. This is based on multiplying the total number of pups counted in southeast Alaska (4,877; Pitcher, ADF&G, unpublished data), British Columbia (3,281; Pitcher, ADF&G, unpublished data), Oregon (1,128; Pitcher, ADF&G, unpublished data), and California (713; Pitcher, ADF&G, unpublished data) by 4.5. This is not a minimum population estimate, since it is extrapolated from pup counts from photographs taken in 2002, and demographic parameters of a stable non-pup population that were estimated for the western Steller sea lion in the mid-1970s (Calkins and Pitcher 1982).

The 4.5 multiplier is used for estimating the size of the eastern stock of Steller sea lions, but not the western stock. The 4.5 multiplier is based on a life history table using age-specific fecundity and survival for a stable population. Clearly, because the western stock has declined drastically, the assumption of a stable population is not valid. Because the eastern stock is increasing within most of its range, using the 4.5 multiplier is a reasonable approach to estimating abundance from pup counts.

### Minimum Population Estimate

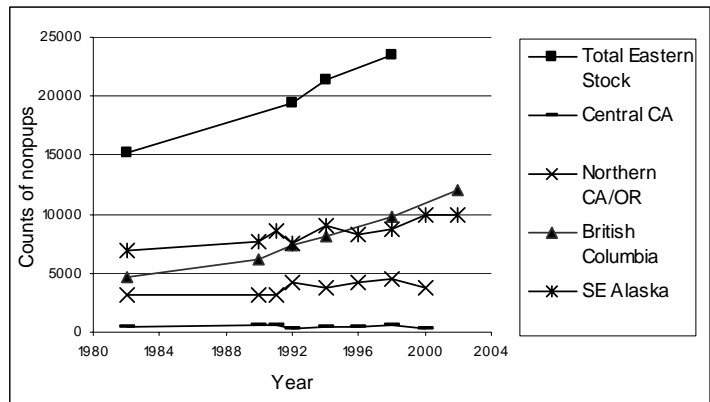
The minimum population estimate will be calculated by adding non-pup counts from 2002 (not trend counts) 1998 counts from Southeast Alaska (15,196/15,283), 1996 counts from WA/OR/CA (6,555), and Canadian counts from 1994 1998 (9,277/11,891), and pup counts from throughout the range from 2002 (9,999), which results in an  $N_{MIN}$  for the eastern U. S. stock of Steller sea lions of 31,028/43,728. Recall that this count has not been corrected for animals which were at sea, and also uses the 1994 data from British Columbia where Steller sea lion numbers are thought to have increased since 1994.

### Current Population Trend

Trend counts (an index to examine population trends) for Steller sea lions in Oregon were relatively stable in the 1980s, with uncorrected counts in the range of 2,000-3,000 sea lions (NMFS 1992). Counts in Oregon have shown a gradual increase since 1976, as the adult and juvenile state-wide count for that year was 1,486 compared to 3,648 in 2001 (Brown and Reimer 1992; Brown et al. 2002).

Steller sea lion numbers in California, especially in southern and central California, have declined from historic numbers. Counts in California between 1927 and 1947 ranged between 5,000 and 7,000 non-pups with no apparent trend, but have subsequently declined by over 50%, remaining between 1,500 and 2,000 non-pups during 1980-2001. Limited information suggests that counts in northern California appear to be stable (NMFS 1995). At Año Nuevo Island off central California, a steady decline in ground counts started around 1970, resulting in an 85% reduction in the breeding population by 1987 (LeBoeuf et al. 1991). In vertical aerial photographic counts conducted at Año Nuevo, pups declined at a rate of 9.9% from 1990 to 1993, while non-pups declined at a rate of 31.5% over the same time period (Westlake et al. 1997). Pup counts at Año Nuevo have been steadily declining at about 5% annually since 1990 (W. Perryman, pers. comm., National Marine Fisheries Service-SWFSC). The most recent pup counts at Año Nuevo and the Farallons are 564 for 1999 and 349 in 2000 and 287 in 2001 (M. Lowry, SWFSC, pers. comm.). Overall, counts of non-pups at trend sites in California and Oregon have been relatively stable since the 1980s (Table 34, Fig. 4).

In Southeast Alaska, counts (no correction factors applied) of non-pups at trend sites increased by 30%<sup>56%</sup> from 1979-2000<sup>2002</sup> from 6,376 to 9,862<sup>9,951</sup> (Merrick et al.; 1992; Sease et al.; 2001; K. Pitcher, ADF&G, pers. comm.). During 1979-97<sup>2001</sup>, counts of pups on the three rookeries in Southeast Alaska increased a total of 114% by an average of 5.9% per year. Since 1989 pup counts on the three rookeries increased at a lower rate (+1.7% per year) than for the entire period (Calkins et al. 1999). A slightly lower increase in pup counts (3.3% per year from 1979-97) is reported by Sease et al. (2001). In British Columbia, counts (no correction factors applied) of non-pups throughout the Province increased at a rate of 2.8% annually during 1971-98 (Table 34, Fig. 4; P. Olesiuk, pers. comm., Pacific Biological Station, Canada). Counts of non-pups at trend sites throughout the range of the eastern U. S. Steller sea lion stock are shown in Figure 4.



**Figure 34.** Counts of adult and juvenile Steller sea lions at rookery and haulout trend sites throughout the range of the eastern U.S. stock, 1982-2000<sup>3</sup>. Data from British Columbia include all sites.

**Table 34.** Counts of adult and juvenile Steller sea lions observed at rookery and haulout trend sites by year and geographical area for the eastern U. S. stock from the 1982 through 2000<sup>2</sup> (NMFS 1995, Strick et al. 1997, Sease et al. 1999, Sease and Loughlin 1999; P. Olesiuk, unpubl. data, Pacific Biological Station, Nanaimo, BC, V9R 5K6 Olesiuk 2003; ODF&W unpubl. data, 7118 NE Vandenberg Ave., Corvallis, OR 97330; Point Reyes Bird Observatory, unpubl. data, 4990 Shoreline Hwy., Stinson Beach, CA 94970; Sease et al.; 2001). Central California data include only Año Nuevo and Farallon Islands. Trend site counts in northern California/Oregon include St. George, Rogue, and Orford Reefs. British Columbia data include counts from all sites. [Note: There are minor differences between the numbers in Table 3 and the numbers provided to the Steller sea lion recovery team for central California and northern California/Oregon (italicized). Revisions will be completed in 2004.]

Area	1982	1990	1991	1992	1994	1996	1998	2000	2002
Central CA	511 <sup>1</sup>	655	537	276	512 508	385 382	208 564	349	n/a
Northern CA/OR	3,094	2,922 3,088	3,180	3,544 4,274	2,834 3,831	2,988 4,192	3,175 4,464	n/a 3,793	n/a
British Columbia	4,711 4,726	6,109 <sup>2</sup> 6,122	no data	7,376 7,378	8,091 8,104	no data	9,818	n/a	n/a 12,121
Southeast Alaska	6,898	7,629	8,621	7,555	9,001	8,231	8,693	9,862 9,892	9,951
Total	15,214 15,229	--	--	18,754 19,483	20,263 21,444	--	21,864 23,539	n/a	n/a

<sup>1</sup> This count includes a 1983 count from Año Nuevo. <sup>2</sup> This count was conducted in 1987.

## CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

There are no estimates of maximum net productivity rates for Steller sea lions. Hence, until additional data become available, it is recommended that the pinniped maximum theoretical net productivity rate ( $R_{MAX}$ ) of 12% be employed for this stock (Wade and Angliss 1997).

## POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 reauthorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor:  $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$ . The default recovery factor ( $F_R$ ) for stocks listed as “threatened” under the Endangered Species Act (ESA) is 0.5 (Wade and Angliss 1997). However, as total

population estimates for the eastern U. S. stock have remained stable or increased over the last 20 years, the recovery factor is set at 0.75; midway between 0.5 (recovery factor for a “threatened” stock) and 1.0 (recovery factor for a stock within its optimal sustainable population level). This approach is consistent with recommendations of the Alaska Scientific Review Group. Thus, for the eastern U. S. stock of Steller sea lions,  $PBR = \frac{1,396,967}{31,028,43,728} \times 0.06 \times 0.75$ .

## ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

### Fisheries Information

Until 2003, there were six different federally-regulated commercial fisheries in Alaska that could have interacted with Steller sea lions and were monitored for incidental mortality by fishery observers. As of 2003, changes in fishery definitions in the List of Fisheries has resulted in separating these six fisheries into 22 fisheries (69 FR 70094, 2 December 2004). This change does not represent a change in fishing effort, but provides managers with better information on the component of each fishery that is responsible for the incidental serious injury or mortality of marine mammal stocks in Alaska.

Fishery observers monitored three-four commercial fisheries during the period from 1990 to 2004<sup>3</sup> in which Steller sea lions from this stock were taken incidentally: the California (CA)/Oregon (OR) thresher shark and swordfish drift gillnet, WA/OR/CA groundfish trawl, and Northern Washington (WA) marine set gillnet, and Gulf of Alaska sablefish longline fisheries. The best data available on the rates of serious injury and mortality incidental to these fisheries is presented in Table 45. There have been no observed serious injuries or mortalities incidental to the CA/OR thresher shark and swordfish drift gillnet fishery in recent years (Caretta 2002, Carretta and Chivers 2003, Carretta and Chivers 2004). Two and one Steller sea lions were observed taken in the WA/OR/CA groundfish trawl in 1997 and 2001, respectively. In the WA/OR/CA groundfish trawl one Steller sea lion was observed killed in each year in 2001-03; these observed takes in combination with a mortality that occurred in an unmonitored haul resulted in a mean estimated annual mortality level of 0.86 (Table 45). In 1996, one Steller sea lion mortality in the northern Washington marine set gillnet fishery was observed. The mortality was not extrapolated because the coastal portion of the fishery (the portion of the fishery most likely to interact with Steller sea lions) was monitored with 100% observer coverage in 1996. This single observed mortality results in a mean annual mortality of 0.2 (CV = 1.0) Steller sea lions for the northern Washington marine set gillnet fishery. No observer program occurred in the during 1994 for this fishery, and no data are available after 1998 for the northern Washington marine set gillnet fishery. One Steller sea lion mortality was observed in the Gulf of Alaska sablefish longline in 2000. These mortalities result in a mean annual mortality rate of 1.97 (CV = 1.64) Steller sea lions. No mortalities were reported by fishery observers monitoring drift gillnet and set gillnet fisheries in Washington and Oregon this decade; though, mortalities have been reported in the past.

**Table 45.** Summary of incidental mortality of Steller sea lions (eastern U. S. stock) due to commercial and tribal fisheries from 1990 to 2004<sup>3</sup> and calculation of the mean annual mortality rate. Mean annual mortality in brackets represents a minimum estimate from self-reported fisheries information or stranding data. Data from 1997 to 2001 (or the most recent 5 years of available data) are used in the mortality calculation when more than 5 years of data are provided for a particular fishery. n/a indicates that data are not available. \* indicates a mortality seen by an observer, but during an unmonitored haul; because the haul was not monitored, no extrapolation can be done. \*\* Aquaculture facilities are no longer permitted to shoot Steller sea lions.

Fishery name	Years	Data type	Range of observer coverage	Observed mortality (in given yrs.)	Estimated mortality (in given yrs.)	Mean annual mortality
CA/OR thresher shark and swordfish drift gillnet	96-00	obs data	4-27%	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0
Gulf of Alaska sablefish longline	1999 2000 2001 2002 2003	Obs data	N/A 6.0 N/A N/A N/A	0 1 0 0 0	0 7 0 0 0	1.37 (CV = 0.92)

Fishery name	Years	Data type	Range of observer coverage	Observed mortality (in given yrs.)	Estimated mortality (in given yrs.)	Mean annual mortality
WA/OR/CA groundfish trawl (Pacific whiting component)	<del>97-01</del> 1999 2000 2001 2002 2003	obs data	<del>66-96%</del> insert values for each year	2, 0, 0, 0, 1 0 0 1 1 1	2, 0, 0, 1*, 1 0 1* 1 1 1	0.8 0.6 (CV = n/a)
Northern WA marine set gillnet (tribal fishery)	<del>94-98</del> 99-03	obs data	47-98%	0, 0, 1, 0, 0 0	0, 0, 1, 0, 0 0	0.2 0 (CV = 1.0)
Observer program total						1.0 1.97 (CV = 1.0)
				<b>Reported mortalities</b>		
Southeast Alaska salmon drift gillnet	<del>90-01</del> 03	self reports	n/a	0, 1, 2, 2, n/a, n/a, n/a, n/a, n/a, n/a, n/a,	n/a	[1.25]
Alaska salmon troll	<del>92-01</del> 03	strand data	n/a	0, 0, 0, 1, 0, 0, n/a, n/a, n/a, 1, 1, n/a, n/a	n/a	[0.24]
British Columbia aquaculture predator control program	<del>91-01</del>  1999 2000 2001 2002 2003	permit reports	n/a	14, 8, 10, 11, 6, 13, 34, 63, 91, n/a, n/a, n/a 91 50 27 15 n/a*	n/a	41.4 0
Minimum total annual incidental mortality (estimate from observer programs plus estimates from self reports and stranding data; includes an estimate of 1.2 rope fishery related strandings per year; see text)						3.85 3.62 (CV = 1.0)
Minimum total annual mortality (includes intentional mortalities in the BC predator control program)						45.3 (CV = 1.0)

An additional source of information on the number of Steller sea lions killed or injured incidental to commercial fishery operations is the self-reported fisheries information required of vessel operators by the MMPA. During the period between 1990 and ~~1998~~2003, fisher self-reports from the Southeast Alaska salmon drift gillnet fishery (Table 45) resulted in an annual mean of 1.25 mortalities from interactions with commercial fishing gear. This total is based on all available fisher self-reports for U. S. fisheries within the range of the stock, except the three fisheries for which observer data were presented above. However, because logbook records (fisher self-reports required during 1990-94) are most likely negatively biased (Credle et al. 1994), these are considered to be minimum estimates. During 1990, 11 Steller sea lion injuries incidental to the Alaska salmon troll fishery and 1 Steller sea lion injury incidental to the CA/OR/WA salmon troll fishery were reported. These injuries were not deemed serious (Angliss and DeMaster 1998) and have not been included in the Table 45. Logbook data are available for part of 1989-1994, after which incidental mortality reporting requirements were modified. Under the new system, logbooks are no longer required; instead, fishers provide self-reports. Data for the 1994-95 phase-in period is fragmentary. After 1995, the level of reporting dropped dramatically, such that the records are considered incomplete and estimates of mortality based on them represent minimums (see Appendix 7 for details).

Strandings of Steller sea lions entangled in fishing gear or with injuries caused by interactions with gear are another source of mortality data. During the 5 year period from 1995 to 1999 there were 4 fishery related strandings



in Southeast Alaska. One of these strandings has been attributed to the Alaska salmon troll fishery and has been included in Table 4. Details regarding which fishery may be responsible for other fishery related strandings between 1994-99 is not available at this time. In 2000, there were reports of 3 Steller sea lions observed in southeast Alaska with “flashers” lodged in their mouths and one animal entangled in fishing line; all animals were alive when seen. It is not clear whether these entanglements resulted from the commercial or recreational fisheries, nor is it clear whether the interactions resulted in mortality. However, based on Angliss and DeMaster (1998), it would be appropriate to call these “serious injuries”. During the 5 year period from 1996-00, there were 6 fishery related strandings; this results in an estimated annual mortality of 1.2 animals from this stock. This estimate is considered a minimum because not all entangled animals strand and not all stranded animals are found or reported.

Strandings of Steller sea lions provide additional information on the level of fishery-related mortality. Estimates of fishery-related mortality from stranding data are considered minimum estimates because not all entangled animals strand, and not all stranded animals are found or reported. In Alaska, during the 5-year period from 1999-2003, there were two situations where a flasher was seen in a Steller sea lion’s mouth and one situation where line was hanging from an animal’s mouth (NMFS Alaska Region unpublished data). It is not clear whether entanglements with “flashers” involved the recreational or commercial component of the salmon troll fishery. Based on Angliss and DeMaster (1998), it is appropriate to call these entanglements “serious injuries”. Based on Alaska stranding records, this information indicates a rate of incidental mortality of at least 0.4/year from the troll fishery. There were no fishery-related strandings of Steller sea lions in Washington, Oregon, or California between 1999-2003.

Due to limited observer program coverage, no data exist on the mortality of marine mammals incidental to Canadian commercial fisheries (i.e., those similar to U.S. fisheries known to take Steller sea lions). As a result, the number of Steller sea lions taken in Canadian waters is not known.

The minimum estimated mortality rate incidental to commercial fisheries (both U.S. and Canadian) is 3.85 sea lions per year, based on observer data (0.71), self-reported fisheries information (1.25), and stranding data (0.2 + 1.2 = 1.4).

#### Subsistence/Native Harvest Information

The subsistence harvest of Steller sea lions during 1997-01 is summarized in Wolfe et al. (2002). During each year, data were collected through systematic interviews with hunters and users of marine mammals in approximately 2,100 households in about 60 coastal communities within the geographic range of the Steller sea lion in Alaska. Approximately 16 of the interviewed communities lie within the range of the eastern U.S. stock. The average number of animals harvested and struck but lost is 24 animals/year.

An unknown number of Steller sea lions from this stock are harvested by subsistence hunters in Canada. The magnitude of the Canadian subsistence harvest is believed to be small. Alaska Native subsistence hunters have initiated discussions with Canadian hunters to quantify their respective subsistence harvests, and to identify any effect these harvests may have on the cooperative management process.

**Table 6.** Summary of the subsistence harvest data for the eastern stock of Steller sea lions, 2000-03 (Wolfe et al. 2004). The number harvested and number struck and lost do not sum to the estimated number take due to rounding error.

Year	Estimated total number taken	Number harvested	Number struck and lost
2000	2	2	0
2001	0	0	0
2002	7	7	0
2003	7	2	4
Mean annual take (2000-03)	4	2	1

#### Other Mortality

Illegal shooting of sea lions in U.S. waters was thought to be a potentially significant source of mortality prior to the listing of sea lions as “threatened” under the ESA in 1990. Such shooting has been illegal since the species was listed as threatened. (Note: the 1994 Amendments to the MMPA made intentional lethal take of any marine mammal illegal except for subsistence hunting by Alaska Natives or where imminently necessary to protect human life). Records from NMFS enforcement indicate that there were 2 cases of illegal shootings of Steller sea

lions in Southeast Alaska between 1995 and 1999: the cases involved the illegal shooting of one Steller sea lion near Sitka in 1998, and 3 Steller sea lions in Petersburg. Both cases were successfully prosecuted (NMFS, Alaska Enforcement Division). For Alaska, NMFS enforcement records provide an indication of the number of Steller sea lions that were illegally shot: no records of illegal shooting of Steller sea lions from the eastern stock are listed in the NMFS enforcement records for 1999-2003 (NMFS, unpublished data).

Steller sea lions are taken in British Columbia during commercial salmon farming operations (Table 45). Preliminary figures from the British Columbia Aquaculture Predator Control Program indicated a mean annual mortality of 44.75 Steller sea lions from this stock over the period from 1995 to 1999 (Olesiuk 2004P, Olesiuk, pers. comm., Pacific Biological Station, Canada). Note that the 1995 estimate includes one animal reported as an unidentified sea lion and the 1996 estimate is based on data from only the first three quarters of 1996. The take of Steller sea lions has increased in recent years because of recent changes in sea lion distribution which have likely occurred in response to a shift in herring distribution (P. Olesiuk, pers. comm). As of 2004, aquaculture facilities are no longer permitted to shoot Steller sea lions (P. Olesiuk, pers. comm).

Strandings of Steller sea lions with gunshot wounds do still occur, along with strandings of animals entangled in gear/material that is not fishery-related. During the period from 1999-2003 1996 to 1999 human-related strandings of animals with gunshot wounds from this stock occurred in Oregon and Washington, and Alaska in 1996 (2 animals), 1997 (3 animals), 1998 (1 animal), and 1999 (2 animals) resulting in an estimated annual mortality of 2.00.2 Steller sea lions from this stock during 1996-99 1999-2003. This estimate is considered a minimum because not all stranded animals are found, reported, or cause of death determined (via necropsy by trained personnel). In addition, human-related stranding data are not available for British Columbia. Reports of stranded animals in Alaska with gunshot wounds have not been included in the above estimates because. However, it is not possible to tell whether the animal was illegally shot or if the animal was struck and lost by subsistence hunters (in which case the mortality would have been legal and accounted for in the subsistence harvest estimate). However, one of the two 1996 reports was from Alaska and has been included because there were no subsistence struck and lost reports during that year.

Stranding data may also provide information on additional sources of potential human-related mortality. In 2000, 3 Steller sea lions were sighted entangled in some kind of rope or line that was not necessarily related to a commercial or recreational fishery, and one animal was seen entangled in a 14" tire. All of these animals were alive when sighted; the animal entangled in the tire was successfully released. In 2001, one Steller sea lion was observed with a propeller or head injury. In 2003, one Stellers sea lion was observed with a piece of cargo net around it's neck. It is not clear whether the occurrence of these interactions in stranding data in 2000 but not in previous years reflects an increase in these types of interactions or an increase in reporting. If the number of interactions (6) is averaged over 5 years, the "other" interaction rate would be a minimum of one 1.1 animal per year.

## STATUS OF STOCK

Based on currently available data, the minimum estimated fishery mortality and serious injury for this stock  $(0.71.97 + 1.2565 + 0.24 + 41.41.1 = 45.55.12)$  is less than that 10% of the calculated PBR (440197) and, therefore, can be considered to be insignificant and approaching a zero mortality and serious injury rate. The estimated annual level of total human-caused mortality and serious injury from fishery interactions, and subsistence harvests, and shootings  $(44 + 0 + 2 = 464.02 + 4 + 1.1 = 9.12)$  does not exceed the PBR (1,3961967) for this stock. The eastern U.S. stock of Steller sea lion is currently listed as "threatened" under the ESA, and therefore designated as "depleted" under the MMPA. As a result, this stock is classified as a strategic stock. Although the stock size has increased in recent years, the status of this stock relative to its Optimum Sustainable Population size is unknown.

## Habitat Concerns

Unlike the observed decline in the western U. S. stock of Steller sea lion there has not been a concomitant decline in the eastern U. S. stock. Concerns regarding the possible impacts of commercial groundfish fisheries in the Gulf of Alaska and Bering Sea have been noted previously (see Habitat Concerns section in assessment report for the western U. S. stock). However, the eastern U. S. stock is stable or increasing in throughout the northern portion of its range (Southeast Alaska and British Columbia). The stock has been declining in the southern end of its range (see Current Population Trend; Fig. 4), where habitat concerns include reduced prey availability, contaminants, and disease (Sydeman and Allen 1997).

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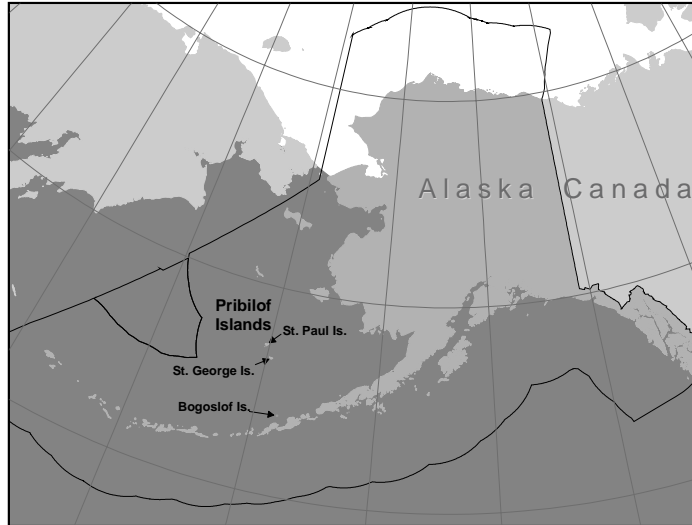


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## NORTHERN FUR SEAL (*Callorhinus ursinus*): Eastern Pacific Stock

### STOCK DEFINITION AND GEOGRAPHIC RANGE

Northern fur seals occur from southern California north to the Bering Sea (Fig. 5) and west to the Okhotsk Sea and Honshu Island, Japan. During the breeding season, approximately 74% of the worldwide population is found on the Pribilof Islands in the southern Bering Sea, with the remaining animals spread throughout the North Pacific Ocean (Lander and Kajimura 1982). Of the seals in U. S. waters outside of the Pribilof Islands, approximately 43% of the population is found on Bogoslof Island in the southern Bering Sea and on San Miguel Island off southern California (NMFS 1993). Northern fur seals may temporarily haul out onto land at other sites in Alaska, British Columbia, and on islets along the coast of the continental United States, but generally do so outside of the breeding season (Fiscus 1983).



**Figure 45.** Approximate distribution of northern fur seals in the eastern North Pacific (shaded area).

Due to differing requirements during the annual reproductive season, adult males and females typically occur ashore at different, though overlapping times. Adult males usually occur on shore during the 4-month period from May-August, though some may be present until November (well after giving up their territories). Adult females are found ashore for as long as 6 months (June-November). Following their respective times ashore, seals of both genders then migrate south and spend the next 7-8 months at sea (Roppel 1984). Adult females and pups from the Pribilof Islands migrate through the Aleutian Islands into the North Pacific Ocean, often to the Oregon and California offshore waters (Ream et al. 2005). Many pups may remain at sea for 22 months before returning to their rookery of birth. Adult males generally migrate only as far south as the Gulf of Alaska in the eastern North Pacific (Kajimura 1984) and the Kuril Islands in the western North Pacific (Loughlin et al. 1999). There is considerable interchange of individuals between rookeries.

The following information was considered in classifying stock structure based on the Dizon et al. (1992) phylogeographic approach: 1) Distributional data: geographic distribution is continuous during feeding, geographic separation during the breeding season, high natal site fidelity (Baker et al. 1995; DeLong 1982); 2) Population response data: substantial differences in population dynamics between Pribilof and San Miguel Islands (DeLong 1982, DeLong and Antonelis 1991, NMFS 1993); 3) Phenotypic data: unknown and 4) Genotypic data: unknown. There is little evidence of genetic differentiation among breeding islands in the Bering Sea (Ream 2002). Based on this information, two separate stocks of northern fur seals are recognized within U. S. waters: an Eastern Pacific stock and a San Miguel Island stock. The San Miguel Island stock is reported separately in the Stock Assessment Reports for the Pacific Region.

### POPULATION SIZE

The population estimate for the Eastern Pacific stock of northern fur seals is calculated as the estimated number of pups at rookeries multiplied by a series of different expansion factors determined from a life table analysis to estimate the number of yearlings, 2 year olds, 3 year olds, and animals at least 4 years old (Lander 1981). The resulting population estimate is equal to the pup count multiplied by 4.5. The expansion factor is based on a sex and age distribution estimated after the harvest of juvenile males was terminated. Currently, CVs are unavailable for the expansion factor. As the great majority of pups are born on the Pribilof Islands, pup estimates are concentrated on these islands, though additional counts have been made on Bogoslof Island. Since 1990, pup counts have occurred biennially on St. Paul and St. George Islands, although less frequently on Sea Lion Rock and Bogoslof Island (Table 5a7). The most recent estimate for the number of fur seals in the Eastern Pacific stock,

based on the preliminary pup count from 2004, is 688,028 (4.5 x 152,895), an average of counts from 1998, 2000, and 2002 is approximately 888,120 (4.5 x 197,360).

**Table 5a7.** Estimates and/or counts of northern fur seal pups born on the Pribilof Islands and Bogoslof Island. Standard errors and the CV for haulout locations and the total abundance estimate, respectively, are provided in parentheses.

Year	Haulout location				Total
	St. Paul	Sea Lion Rock	St. George	Bogoslof	
1992 <sup>1*</sup>	182,437 (8,919)	10,217 (568)	25,160 (707)	898 (n/a)	218,712 (0.041)
1994	192,104 (8,180)	12,891 (989)	22,244 (410)	1,472 (n/a)	228,711 (0.036)
1996 <sup>2</sup>	170,125 (21,244)	12,891 (989) <sup>“</sup>	27,385 (294)	1,272 (n/a)	211,673 (0.10)
1998 <sup>3</sup>	179,149 (6,193)	12,891 (989) <sup>“</sup>	22,090 (222)	5,096 (33)	219,226 (0.029)
2000 <sup>4</sup>	158,736 (17,284)	12,891 (989) <sup>“</sup>	20,176 (271)	5,096 (33) <sup>“</sup>	196,899 (0.089)
2002 <sup>4</sup>	145,701 <b>716</b> (1,629)	8,098 (191)	17,593 (527)	5,096 (33) <sup>“</sup>	175,955 <b>176,503</b> (0.01)
<b>2004<sup>**</sup></b>	<b>122,825</b> <b>(1290)</b>	<sup>“</sup>	<b>16,876</b> <b>(415)</b>	<sup>“</sup>	<b>152,895</b> <b>(0.01)</b>

1\* Incorporates the 1990 est. for Sea Lion Rock and the 1993 count for Bogoslof Is.

2 Incorporates the 1994 est. for Sea Lion Rock and the 1995 count for Bogoslof Is.

3 Incorporates the 1994 est. for Sea Lion Rock and the 1997 count for Bogoslof Is.

4 Incorporates the 1994 est. for Sea Lion Rock and the 1999 count for Bogoslof Is.

**\*\* Preliminary data from 2004**

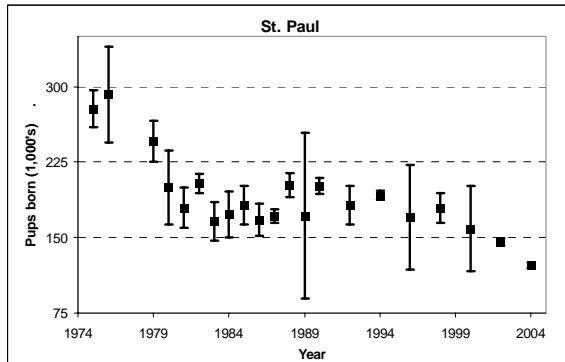
### Minimum Population Estimate

A CV(N) that incorporates the variance due to the correction factor is not currently available. Consistent with a recommendation of the Alaska Scientific Review Group (SRG) and recommendations contained in Wade and Angliss (1997), a default CV(N) of 0.2 was used in the calculation of the minimum population estimate ( $N_{MIN}$ ) for this stock (DeMaster 1998).  $N_{MIN}$  is calculated using Equation 1 from the PBR Guidelines (Wade and Angliss 1997):  $N_{MIN} = N/\exp(0.842 \times [\ln(1 + [CV(N)]^2)]^{1/2})$ . Using the population estimate (N) of 888,120 **688,028** and the default CV (0.2),  $N_{MIN}$  for the Eastern Pacific stock of northern fur seals is **751,714** **676,540**.

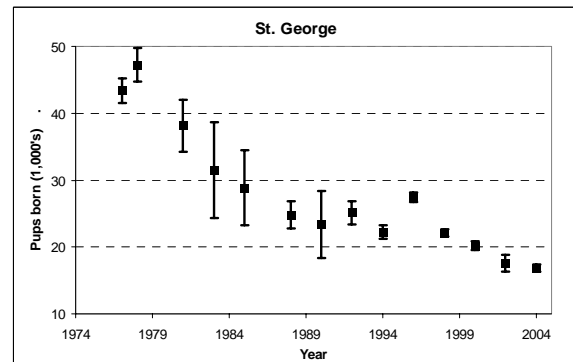
### Current Population Trend

The Alaska population of northern fur seals increased to approximately 1.25 million in 1974 after the killing of females in the pelagic fur seal harvest was terminated in 1968. The population then began to decrease with pup production declining at a rate of 6.5-7.8% per year into the 1980s (York 1987). By 1983 the total stock estimate was 877,000 (Briggs and Fowler 1984). Annual pup production on St. Paul Island has remained relatively stable between 1981 and 1995<sup>6</sup> (Fig. 6a), indicating that stock size has not changed much in recent years (York and Fowler 1992). **There has been a decline in pup production on St. Paul Island since the mid-1990s.** The 1996 estimate of number of pups born on St. Paul Island is not significantly different from the 1990, 1992, or 1994 estimates (York et al. 1997). However, the 2000 estimate of the number of pups born was 10% less than the 1992 count and 6% less than the 1996 count. Although there was a slight increase in the number of pups born on St. George Island in 1996, the number of pups born declined between 1996 and 1998, and the 1998 counts were similar to those obtained in 1990, 1992, and 1994 (Fig. 6b<sup>7</sup>). During 1998-02, pup production declined **5.144.99%** per year (SE = 0.27%; **p = 0.03**) on St. Paul Island and **5.355.29%** per year (SE = 0.1972%; **p = 0.08**) on St. George Island (A. York, pers. communication, October 2002 NMML unpublished data). **Based on preliminary data from 2004, the pup production estimate in 2004 was 15.7% and 4.1% below the 2002 estimates on St. Paul Island and St. George Island, respectively.** Counts in both 2000, and 2002, and preliminary counts from 2004 were lower than previous

years; the estimated pup production is now below the 1921 level on St. Paul Island and below the 1916 level on St. George Island.



**Figure 5a6.** Estimated number of northern fur seal pups born on St. Paul Island, 1970-2004.



**Figure 5b7.** Estimated number of northern fur seal pups born on St. George Island, 1970-2004.

The northern fur seal was designated as “depleted” under the Marine Mammal Protection Act (MMPA) in 1988 because population levels had declined to less than 50% of levels observed in the late 1950s (1.8 million animals; 53 FR 17888, 18 May 1988) and there was no compelling evidence that carrying capacity (K) had changed substantially since the late 1950s (NMFS 1993). Under the MMPA, this stock will remain listed as depleted until population levels reach at least the lower limit of its optimum sustainable population (estimated at 60% of K; 1,080,000).

#### CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

The northern fur seal population increased steadily during 1912-24 after the commercial harvest no longer included pregnant females. During this period, the rate of population growth was approximately 8.6% (SE = 1.47) per year (A. York unpubl. data, National Marine Mammal Laboratory, 7600 Sand Point Way NE, Seattle, WA 98115), the maximum recorded for this species. This growth rate is similar and slightly higher than the 8.12% rate of increase (approximate SE = 1.29) estimated by Gerrodette et al. (1985). Though not as high as growth rates estimated for other fur seal species, the 8.6% rate of increase is considered a reliable estimate of  $R_{MAX}$  given the extremely low density of the population in the early 1900s.

#### POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 reauthorized MMPA, the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor:  $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$ . The recovery factor ( $F_R$ ) for this stock is 0.5, the value for depleted stocks under the MMPA (Wade and Angliss 1997). Thus, for the Eastern Pacific stock of northern fur seals,  $PBR = 46,162$  animals ( $751,714 \times 0.043 \times 0.5$ ).

#### ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

##### Fisheries Information

The NMFS estimate of the total number of northern fur seals killed incidental to both the foreign and the joint U. S.-foreign commercial groundfish trawl fisheries in the North Pacific from 1978 to 1988 was 246 (95% CI: 68 - 567), resulting in an estimated mean annual rate of 22 northern fur seals (Perez and Loughlin 1991). The foreign high seas driftnet fisheries also incidentally killed large numbers of northern fur seals, with an estimated 5,200 (95% CI: 4,500 - 6,000) animals taken during 1991 (Larntz and Garrott 1993). These estimates were not included in the mortality rate calculation because the fisheries are no longer operative, although some low level of illegal fishing may still be occurring. Commercial net fisheries in international waters of the North Pacific Ocean have decreased significantly in recent years. The assumed level of incidental catch of northern fur seals in those fisheries, though unknown, is thought to be minimal (T. Loughlin, pers. comm., National Marine Fisheries Service).

Six different commercial fisheries in Alaska that could have interacted with northern fur seals were monitored for incidental take by fishery observers during 1990-01: Bering Sea (and Aleutian Islands) groundfish trawl, longline, and pot fisheries, and Gulf of Alaska groundfish trawl, longline, and pot fisheries. Until 2003, there were six different federally-regulated commercial fisheries in Alaska that could have interacted with northern fur seals and were monitored for incidental mortality by fishery observers. As of 2003, changes in fishery definitions in the List of Fisheries has resulted in separating these six fisheries into 22 fisheries (69 FR 70094, 2 December 2004). This change does not represent a change in fishing effort, but provides managers with better information on the component of each fishery that is responsible for the incidental serious injury or mortality of marine mammal stocks in Alaska. The only federally observed fishery in which incidental mortality occurred was the Bering Sea and Aleutian Islands groundfish flatfish trawl (Table 58, with a mean annual (total) mortality of 1.5 (CV = 0.63) 0.48 (95% CI = 0.20 – 0.57).

Observer programs for three-five Alaska commercial fisheries have not documented any takes of fur seals. In 1990 and 1991, observers monitored the Prince William Sound salmon drift gillnet fishery and recorded no mortalities of northern fur seals. In 1990, observers boarded 300 (57.3%) of the 524 vessels that fished in the Prince William Sound salmon drift gillnet fishery, monitoring a total of 3,166 sets, or roughly 4% of the estimated number of sets made by the fleet (Wynne et al. 1991). In 1991, observers boarded 531 (86.9%) of the 611 registered vessels and monitored a total of 5,875 sets, or roughly 5% of the estimated sets made by the fleet (Wynne et al. 1992). During 1990, observers also boarded 59 (38.3%) of the 154 vessels participating in the Alaska Peninsula/Aleutian Islands salmon drift gillnet fishery, monitoring a total of 373 sets, or roughly 4% of the estimated number of sets made by the fleet (Wynne et al. 1991). Although no interaction with northern fur seals was recorded by observers in 1990 and 1991 in these fisheries, due in part to the low level of observer coverage, mortalities did occur as recorded in fisher self-reports (see Table 5b8). Observer programs have recently been implemented in the Cook Inlet salmon set and drift gillnet fisheries (Manly in review) and in a portion of the Kodiak drift gillnet fishery (Manly et al in review). Observer coverage in the Cook Inlet drift gillnet fishery was 1.75% and 3.73% in 1999 and 2000, respectively. The observer coverage in the Cook Inlet set gillnet fishery was 7.3% and 8.3% in 1999 and 2000, respectively (Manly in review). Observer coverage in the Kodiak drift gillnet fishery was 7.5% of the fishing permit days. No serious injuries or mortalities of northern fur seals were observed during the course of either observer program.

An additional source of information on the number of northern fur seals killed or injured incidental to commercial fishery operations is the self-reported fisheries information required of vessel operators by the MMPA. During the period between 1990 and 1999-2003, fisher self-reports from three unobserved fisheries (see Table 5b8) resulted in an annual mean of 14.5 mortalities from interactions with commercial fishing gear. While logbook records (fisher self-reports required during 1990-94) are most likely negatively biased (Credle et al. 1994), the bias in these estimates are hard to quantify because at least in one area (Prince William Sound), it is unlikely that fur seals occur and reports of fur seal-fishery interactions are likely the result of species misidentification. The great majority of the incidental take in fisher self-reports occurred in the Bristol Bay salmon drift net fishery. In 1990, self-reports from the Bristol Bay set and drift gillnet fisheries were combined. As a result, some of the northern fur seal mortalities reported in 1990 may have occurred in the set net fishery. Logbook data are available for part of 1989-1994, after which incidental mortality reporting requirements were modified. Under the new system, logbooks are no longer required; instead, fishers provide self-reports. Data for the 1994-95 phase-in period is fragmentary. After 1995, the level of reporting dropped dramatically, such that the records are considered incomplete and estimates of mortality based on them represent minimums (see Appendix 7 for details).

**Table 5b8.** Summary of incidental mortality of northern fur seals (Eastern Pacific stock) due to commercial fisheries from 1990 through 2001-2003 and calculation of the mean annual mortality rate. Mean annual mortality in brackets represents a minimum estimate from self-reported fisheries information. Data from 1997 to 2001-2003 (or the most recent 5 years of available data) are used in the mortality calculation when more than 5 years of data are provided for a particular fishery. n/a indicates that data are not available.

Fishery name	Years	Data type	Range of observer coverage	Observed mortality (in given yrs.)	Estimated mortality (in given yrs.)	Mean annual mortality
Bering Sea/Aleutian Islands groundfish trawl	97-01	obs data	53-74%	0 1 1 0 1	0 4 2 1 2	1.5 (CV = 0.63xxx)
Bering Sea/Aleutian Islands flatfish trawl	1999 2000 2001 2002 2003	obs data	66.3 64.5 57.6 58.4 63.9	0 0 1 0 0	0 1 1 0 0	0.48 (CV = 0.53)
Observer program total						1.50.48 (CV = 0.63) (CV = 0.53)
				<b>Reported mortalities</b>		
Prince William Sound salmon drift gillnet	90-0103	self reports	n/a	1, 1, 0, 0; n/a, n/a, n/a; n/a, n/a, n/a; n/a, n/a, n/a; 1994-2003: n/a	n/a	[0.5]
Alaska Peninsula/Aleutian Islands salmon drift gillnet	90-0103	self reports		2, 0, 0, 0; n/a, n/a, n/a; n/a, n/a, n/a; n/a, n/a, n/a; 1994-2003: n/a	n/a	[0.5]
Bristol Bay salmon drift gillnet	90-0103	self reports	n/a	5, 0, 49, 0; n/a, n/a, n/a; n/a, n/a, n/a; n/a, n/a, n/a; 1994-2003: n/a	n/a	[13.5]
Minimum total annual mortality						16.015 (CV = 0.630.53)

There are several fisheries which are known to interact with northern fur seals and have not been observed (Appendices 4 and 5). Thus, No observers have been assigned to several of the gillnet fisheries that are known to interact with this stock, making the estimated mortality rate is likely conservative-unreliable. However, the large stock size makes it unlikely that unreported mortalities from those fisheries would be a significant source of mortality for the stock. The estimated minimum annual mortality rate incidental to commercial fisheries is 16.15 fur seals per year based on observer data (1.50.48), and self-reported fisheries information (14.5) where observer data were not available.

Entanglement studies on the Pribilof Islands are another source of information on fishery-specific entanglements. Based on entanglement rates and sample sizes presented in Zavadil et al. (2003), an average of 1.1



fur seals/year on the rookeries was entangled in pieces of trawl netting and an average of 0.1 fur seal/year was entangled in monofilament net.

Anecdotal reports of northern fur seals entangled in fishing gear or with injuries caused by interactions with gear are another source of mortality data. During the 5-year period from 1998-02 the only fishery-related northern fur seal stranding was reported in September 2001 near Unalaska as entangled in 8 inch poly trawl web. The animal was cut free and was apparently healthy. The NMFS stranding database includes reports of 4 fur seals on St. George that were entangled in fishing gear in 2003; including these animals in an annual average will be delayed until comparisons between these data and those from entanglement studies (e.g., Zavadil et al. 2003) can be cross-referenced.

### Subsistence/Native Harvest Information

Alaska Natives residing on the Pribilof Islands are allowed an annual subsistence harvest of northern fur seals, with a take range determined from annual household surveys. From 1986 to 1996, the annual subsistence harvest level averaged 1,412 and 193 for St. Paul and St. George Islands, respectively, for a total of 1,605. The subsistence harvest levels from 1997 to 2001 were 1,380, 1,558, 1,193, 750, and 781. The average subsistence harvest level for 1997-01 is 1,132. Only juvenile males are taken in the subsistence harvest, which likely results in a much smaller impact on population growth than a harvest of equal proportions of males and females. A few females were taken in 1996, 1997, and 1998, but no females are known to have been taken since the late 1990s (NMFS 2004)(3 in 1996, 3 in 1997, and 5 in 1998) were accidentally taken. Subsistence take in areas other than the Pribilof Islands is known to occur, though believed to be minimal (NMFS unpubl. data, National Marine Mammal Laboratory, 7600 Sand Point Way NE, Seattle, WA 98115). Between 1999-2003, there was an annual average of 869 seals harvested per year in the subsistence hunt (Table 9).

**Table 13a9.** Summary of the Alaska Native subsistence harvest of northern fur seals on St. Paul and St. George Islands St. Paul data provided in (Lestenkof and Zavadil 2001, and Zavadil and Lestenkof 2003); St. George data provided by NMFS (D. Cormany, NMFS, pers. comm.)

Year	St. Paul	St. George	Total harvested
1999	1000	193	1193
2000	747	121	868
2001	597	184	781
2002	648	203	851
2003	522	132	654
Mean annual take (1999-2003)			869

<sup>†</sup> Does not include the number of struck and lost; <sup>‡</sup> Indicates a lower bound.

### Other Mortality

Intentional killing of northern fur seals by commercial fishers, sport fishers, and others may occur, but the magnitude of this mortality is unknown. Such shooting has been illegal since the species was listed as “depleted” in 1988. (Note: the 1994 Amendments to the MMPA made intentional lethal take of any marine mammal illegal except for subsistence hunting by Alaska Natives or where imminently necessary to protect human life).

Mortality resulting from entanglement in marine debris has been implicated as a contributing factor in the decline observed in the northern fur seal population on the Pribilof Islands during the 1970s and early 1980s (Fowler 1987, Swartzman et al. 1990, Fowler 2002). Surveys conducted from 1995 to 1997 on St. Paul Island indicate a rate of entanglement among subadult males comparable to the 0.2% rate observed from 1988 to 1992 (Fowler and Ragen 1990, Fowler et al. 1994), which is lower than the rate of entanglement (0.4%) observed during 1976-85 (Fowler et al. 1994). During 1995-97, NMFS researchers in conjunction with members of the Aleut communities of St. Paul and St. George Islands captured and removed entangling debris (including trawl net, packing bands, twine, and miscellaneous items) from 88, 146 and 87 northern fur seals, respectively. Between 1995 and 2000, responsibility for entanglement studies of northern fur seals shifted gradually from NMML to the Tribal Government of St. Paul’s Ecosystem Conservation Office (ECO). ECO has managed the entanglement studies under a co-management agreement with NOAA for northern fur seals since 2000. Entanglement rates of male northern fur seals on St. Paul from 1998-02 were 0.2, 0.26, 0.25, 0.3, and 0.37 (Zavadil et al. 2003). The recent rates of entanglements are close to those recorded in the mid-1980s; however, recent changes in methodology (counting juvenile males vs. all males) make direct comparisons between recent and historical data difficult (Zavadil et al. 2003). In 2002, the composition

of entangling debris switched from predominantly packing bands to trawl net fragments (Zavadil et al. 2003). The NMFS stranding database includes reports of 5 fur seals on St. George that were entangled in debris in 2003; including these animals in an annual average will be delayed until comparisons between the NMFS data and those from entanglement studies (e.g., Zavadil et al. 2003) can be cross-referenced.

## STATUS OF STOCK

Based on currently available data, the minimum estimated fishery mortality and serious injury for this stock (4715) is less than 10% of the calculated PBR (4,790,1455) and, therefore, can be considered to be insignificant and approaching a zero mortality and serious injury rate. The estimated annual level of total human-caused mortality and serious injury ( $4715 + 1,132,869 + 1.1 = 1,149,885.1$ ) is not known to exceed the PBR (46,162,14,546) for this stock. The Eastern Pacific stock of northern fur seal is classified as a strategic stock because it is designated as “depleted” under the MMPA. The Alaska SRG has noted that the multiplier used to convert pup counts to total population size is likely negatively biased and that the estimate of the current population size using the existing multiplier is only marginally less than 60% of the best available estimate of K (DeMaster 1996). Therefore, the Alaska SRG has recommended that the NMFS undertake research to evaluate the degree to which the currently used multiplier may be biased, and if necessary, consider re-evaluating the status of this stock relative to carrying capacity.

## Habitat Concerns

Recent rapid development on the Pribilof Islands increases the potential for negatively affecting habitat used by northern fur seals. Associated with the development on the islands comes the nearshore discharge of seafood processing waste, oil and contaminant spills, increased direct human disturbance, and increased levels of noise and olfactory pollution. Preliminary data suggest that the development on St. Paul Island may be impacting fur seal rookeries as pup production has declined on two of the three rookeries in closest proximity to human habitation and to the sewer and processor outfalls. Studies designed to assess the potential impact of human and industrial development on the Pribilofs have been planned.

Northern fur seals forage on a variety of fish species, including pollock (34% of fish species consumed between 1958-1974 ; Perez 1997). In the 1990s, some prey items, such as capelin, have disappeared entirely from fur seal diet and pollock consumption has tripled (Sinclair et al. 1994, Sinclair et al. 1996, Antonelis et al. 1997). Fishing effort displaced by Steller sea lion protection measures may have moved to areas important to fur seals; recent tagging studies have shown that lactating female fur seals from St. Paul and St. George Islands forage in specific, and very different areas (Robson et al. 2004). The proportion of the total June-October pollock catch in fur seal foraging habitat (defined as the combined home ranges of females from the Pribilofs) increased from an average of 40% between 1995 and 1998 to 65% from 1999 to 2002 (NMFS unpublished data). The impact, if any, of this shift in fishing effort on the northern fur seal population is unknown.

There is concern that a variety of human activities other than commercial fishing may impact northern fur seals. These activities will be identified in a conservation plan that is currently being developed by NMFS and research projects to address the levels of impact will be recommended in that document.

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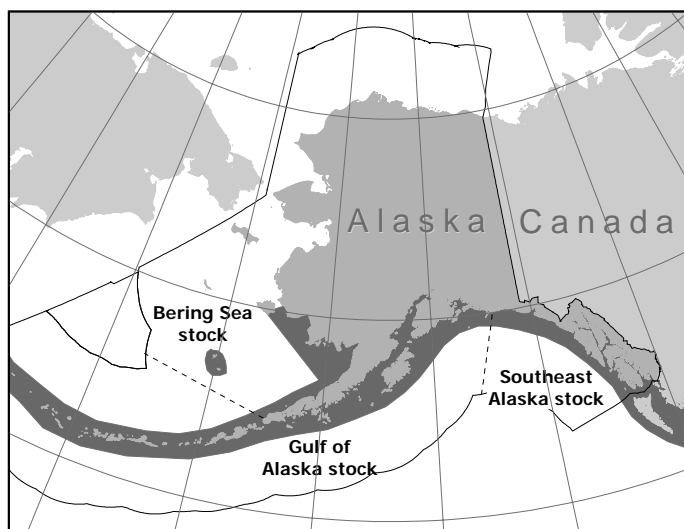
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### HARBOR SEAL (*Phoca vitulina richardsi*): Southeast Alaska Stock

**NOTE - August 2002:** NMFS has new genetic information on harbor seals in Alaska which indicates that the current boundaries between the Southeast Alaska, Gulf of Alaska, and Bering Sea stocks of harbor seals in Alaska need to be reassessed. NMFS, in cooperation with our partners in the Alaskan Native community, is evaluating the new genetic information and hopes to make a joint recommendation regarding stock structure in 2003. A complete revision of the harbor stock assessments will be postponed until new stocks are defined.

#### STOCK DEFINITION AND GEOGRAPHIC RANGE

Harbor seals inhabit coastal and estuarine waters off Baja California, north along the western coasts of the United States, British Columbia, and Southeast Alaska, west through the Gulf of Alaska and Aleutian Islands, and in the Bering Sea north to Cape Newenham and the Pribilof Islands. They haul out on rocks, reefs, beaches, and drifting glacial ice, and feed in marine, estuarine, and occasionally fresh waters. Harbor seals generally are non-migratory, with local movements associated with such factors as tides, weather, season, food availability, and reproduction (Scheffer and Slipp 1944; Fisher 1952; Bigg 1969, 1981). The results of recent satellite tagging studies in Southeast Alaska, Prince William Sound, and Kodiak are also consistent with the conclusion that harbor seals are non-migratory (Frost et al. 1996, Swain et al. 1996). However, some long-distance movements of tagged animals in Alaska have been recorded (Pitcher and McAllister 1981, Frost et al. 1996). Strong fidelity of individuals for haulout sites in June and August also has been reported, although these studies considered only limited areas during a relatively short period of time (Pitcher and Calkins 1979, Pitcher and McAllister 1981).



**Figure 58.** Approximate distribution of harbor seals in Alaska waters (shaded area).

The following information was considered in classifying stock structure based on the Dizon et al. (1992) phylogeographic approach: 1) Distributional data: geographic distribution continuous, natal dispersal characteristics unknown, breeding dispersal is presumed to be very limited, year-round site fidelity observed, seasonal movements greater than 300 km rare (Harvey 1987) except in western Alaska (Hoover-Miller 1994); 2) Population response data: substantial differences in population dynamics between Southeast Alaska and the rest of Alaska, and presumed differences between Gulf of Alaska and Bering Sea (Hoover 1988, Hoover-Miller 1994, Withrow and Loughlin 1996); 3) Phenotypic data: clinal variation in body size and color phase (Shaughnessy and Fay 1977, Kelly 1981); 4) Genotypic data: undetermined for Alaska, mitochondrial DNA analyses currently underway. Preliminary genetic data indicate substantial variation in mtDNA suggesting at least two genetically distinct stocks in Alaska (Westlake and O'Corry-Crowe 1997). However, until additional samples are analyzed the Alaska Scientific Review Group (SRG) recommended using the same stock boundaries as in the Stock Assessment Reports for 1996 (Hill et al. 1997).

The Alaska SRG concluded that the scientific data available to support three distinct biological stocks (i.e., genetically isolated populations) were equivocal. However, the Alaska SRG recommended that the available data were sufficient to justify the establishment of three management units for harbor seals in Alaska (DeMaster 1996). Further, the SRG recommended that, unlike the stock structure reported in Small and DeMaster (1995), animals in the Aleutian Islands should be included in the same management unit as animals in the Gulf of Alaska. As noted above, this recommendation has been adopted by NMFS with the caveat that management units and stocks are equivalent for the purposes of managing incidental take under section 118 of the Marine Mammal Protection Act

(Wade and Angliss 1997). Therefore, based primarily on the significant population decline of seals in the Gulf of Alaska, the possible decline in the Bering Sea, and the stable population in Southeast Alaska (see Current Population Trend section in the respective harbor seal report for details), three separate stocks are recognized in Alaska waters: 1) the Southeast Alaska stock - occurring from the Alaska/British Columbia border to Cape Suckling, Alaska (144°W), 2) the Gulf of Alaska stock - occurring from Cape Suckling to Unimak Pass, including animals throughout the Aleutian Islands, and 3) the Bering Sea stock - including all waters north of Unimak Pass (Fig. 78). Information concerning the three harbor seal stocks recognized along the West Coast of the continental United States can be found in the Stock Assessment Reports for the Pacific Region.

## POPULATION SIZE

The most recent comprehensive aerial survey of harbor seals in Southeast Alaska was conducted during the autumn molt in 1993. Eleven separate areas, with a mean of 39 (21-59) sites each, were surveyed 5-9 times each; the minimum number of surveys for each of the 427 sites was usually 4 or 5. Ten of 11 areas were surveyed during the third week of September; one area was surveyed from 31 August to 6 September. All known harbor seal haulout sites in each area were surveyed, and reconnaissance surveys were flown prior to photographic surveys to establish the location of additional sites. Aerial surveys were flown within 2 hours on either side of low tide, based on the assumption that at locations affected by tides, harbor seals haul out in greatest numbers at and around the time of low tide (Pitcher and Calkins 1979, Calambokidis et al. 1987). Some of the survey effort was conducted after the molt peak. If it is assumed that harbor seals decrease their amount of time hauled out after the molt, the counts from the 1993 surveys may have underestimated the number of seals. Mathews and Kelly (1996), for instance, suggested more than half of the estimated 6,000 seals found in Glacier Bay in August were not detected in the bay, or within a 60-km radius of the bay, during the September 1993 survey.

The sum of all mean counts was 21,523 with a combined CV = 0.026 (Loughlin 1994). This method of estimating abundance and its CV assumes that during the survey period no migration occurred between sites and that there was no trend in the number of animals ashore. The number of seals moving between areas was assumed to be small considering each area's large geographic size, though a small number of seals may have been counted twice, or not at all. Data collected from 36 tagged harbor seals in Southeast Alaska from 1 to 11 September 1994 resulted in a correction factor of 1.74 (CV = 0.068) to account for animals in the water which are thus missed during the aerial surveys (Withrow and Loughlin 1995). Although this correction factor (CF) was not derived during the actual survey in 1993, it was considered conservative because the data used to develop the CF were collected during a time period (early September) when seals are assumed to spend more time on haulouts than when the surveys were flown in 1993 (late September). Utilizing this correction factor results in a population estimate of 37,450 ( $21,523 \times 1.74$ ; CV = 0.073) for the Southeast Alaska stock of harbor seals.

It should be noted that the CF developed for tidally influenced rocky substrate may not apply to seals hauled on ice from tidewater glaciers (Alaska SRG, see DeMaster 1996). Given the relatively small number of harbor seals counted on glacial haulouts, the magnitude of any bias resulting from using an inappropriate CF is likely small. That is, if no CF were applied to the counts of seals hauled on glacial haulouts during the 1993 surveys, the resulting abundance estimate for Southeast Alaska would be reduced by approximately 3% or 1,000 animals. NMFS will attempt to capture and radio-tag seals that utilize glacial haulouts prior to the next survey in Southeast Alaska. If such efforts are unsuccessful, pending recommendations from the Alaska SRG, NMFS will reconsider the methods used to correct for the number of seals hauled on glacial haulouts.

## Minimum Population Estimate

The minimum population estimate ( $N_{\text{MIN}}$ ) for this stock is calculated using Equation 1 from the PBR Guidelines (Wade and Angliss 1997):  $N_{\text{MIN}} = N / \exp(0.842 \times [\ln(1 + [CV(N)]^2)]^{1/2})$ . Using the population estimate (N) of 37,450 and its associated CV(N) of 0.073,  $N_{\text{MIN}}$  for this stock of harbor seals is 35,226.

## Current Population Trend

Population trend data have been collected in the vicinity of Sitka and Ketchikan since 1983. When counts from 1993 were compared with those made in the early 1980s, mean counts of harbor seals at both locations were lower. However, this is probably explained by the late survey dates in 1993. Mean counts from both trend routes have increased since 1983. The mean count for the Ketchikan trend route was 2,708 in 1996, an increase of 3.8% from the 1995 count. The number of harbor seals at the Ketchikan trend sites has increased 9.3% annually (95% CI: 7.5%-11.0%) from 1983 to 1996 (Small et al. 1997). The mean count for the Sitka trend route decreased 21.5% from the 1995 count of 2,041 to 1,602 in 1996. However, trend estimates based on modeling count data and

environmental covariates indicate that the number of harbor seals at the Sitka trend sites has increased 3.0% annually (95% CI: 2.1%-3.9%) from 1983 to 1996 (Small et al. 1997). It should be clear that these data are from selected 'trend' sites and not complete census surveys. Further, both of these trend routes are for terrestrial haul outs, which may not be representative of animals that use glacial haul outs.

Additional information concerning trend counts in Southeast Alaska come from Glacier Bay. The number of harbor seals in Johns Hopkins Inlet (a tidewater glacial fjord in Glacier Bay) increased steeply (30.7% annually) between 1975 and 1978, and then at a slower rate (2.6% annually) for the period from 1983 to 1996 (Mathews and Pendleton 1997). Immigration and reduced mortality may have contributed to the steep growth between 1975 and 1978. During 1992-96, the number of seals in Johns Hopkins Inlet (glacial ice haul out) increased 7.1% annually (95% CI: 1.7%-12.4%), whereas the number of seals using terrestrial haul outs decreased 8.6% annually (95% CI: 5.6%-11.7%) over the same period. The combined effect of the recent divergent trend at glacial ice versus terrestrial haul outs is that numbers in Glacier Bay overall appear to be stable or possibly increasing (Mathews and Pendleton 1997). Results from the Sitka, Ketchikan, and Glacier Bay trend analyses provide a strong indication that the number of harbor seals in Southeast Alaska has been increasing since at least 1983 (Small et al. 1997).

### **CURRENT AND MAXIMUM NET PRODUCTIVITY RATES**

Reliable rates of maximum net productivity have not been estimated for the Southeast Alaska harbor seal stock. Population growth rates of 6% and 8% were observed between 1991 and 1992 in Oregon and Washington, respectively. Harbor seals have been protected in British Columbia since 1970, and the population has responded with an annual rate of increase of approximately 12.5% since 1973 (Olesiuk et al. 1990). However, until additional data become available, it is recommended that the pinniped maximum theoretical net productivity rate ( $R_{MAX}$ ) of 12% be employed for this stock (Wade and Angliss 1997).

### **POTENTIAL BIOLOGICAL REMOVAL**

Under the 1994 reauthorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor:  $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$ . The recovery factor ( $F_R$ ) for this stock is 1.0 (Wade and Angliss 1997), as population levels have increased or remained stable with a known human take (Pitcher 1990, Small et al. 1997). Thus, for this stock of harbor seals,  $PBR = 2,114$  animals ( $35,226 \times 0.06 \times 1.0$ ).

### **ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY**

#### **Fisheries Information**

Some fishing effort by vessels participating in the Gulf of Alaska (GOA) groundfish longline fishery occurs in the offshore waters of Southeast Alaska. Effort levels are insignificant for the portion of the GOA groundfish trawl and pot fisheries operating in these waters. During the period from 1990 to 1996, 21-31% of the GOA longline catch occurred within the range of the Southeast Alaska harbor seal stock. This fishery has been monitored for incidental take by fishery observers from 1990 to 1996 (8-21% observer coverage), although observer coverage has been very low in the offshore waters of Southeast Alaska (Table 6a10). The only observed harbor seal mortality in this fishery occurred in 1995, resulting in a mean annual (total) mortality of 4 (CV = 1.0).

An additional source of information on the number of harbor seals killed or injured incidental to commercial fishery operations is the self-reported fisheries information required of vessel operators by the MMPA. During the period between 1990 and 1996, fisher self-reports from 2 unobserved fisheries (see Table 6a10) resulted in an annual mean of 31.25 mortalities from interactions with commercial fishing gear. However, because logbook records (fisher self-reports required during 1990-94) are most likely negatively biased (Credle et al. 1994), these are considered to be minimum estimates. As recommended by the Alaska SRG, given that harbor seals are the only common phocid in Southeast Alaska, fisher self-reports of unidentified phocid mortalities have been included as incidental takes of harbor seals in Table 6a10 (DeMaster 1996: p. 8). The majority of self-reported incidental takes were reported in the Yakutat salmon set gillnet fishery. Self-reported fisheries data are incomplete for 1994, not available for 1995, and considered unreliable for 1996 (see Appendix 7 for details).



**Table 6a10.** Summary of incidental mortality of harbor seals (Southeast Alaska stock) due to commercial fisheries from 1990 through 1996 and calculation of the mean annual mortality rate. Mean annual mortality in brackets represents a minimum estimate from self-reported fisheries information. Data from 1992 to 1996 (or the most recent 5 years of available data) are used in the mortality calculation when more than 5 years of data are provided for a particular fishery. n/a indicates that data are not available.

<b>Fishery name</b>	<b>Years</b>	<b>Data type</b>	<b>Range of observer coverage</b>	<b>Observed mortality (in given yrs.)</b>	<b>Estimated mortality (in given yrs.)</b>	<b>Mean annual mortality</b>
Gulf of Alaska groundfish longline (incl. misc. finfish and sablefish fisheries)	90-96	obs data	<1-5%	0, 0, 0, 0, 0, 1, 0	0, 0, 0, 0, 0, 20, 0	4 (CV = 1.0)
Observer program total						4 (CV = 1.0)
				<b>Reported mortalities</b>		
Southeast Alaska salmon drift gillnet	90-96	self reports	n/a	8, 1, 4, 2, n/a, n/a, n/a	n/a	[3.75]
Yakutat salmon set gillnet	90-96	self reports	n/a	0, 18, 31, 61, n/a, n/a, n/a	n/a	[27.5]
Minimum total annual mortality						35.25 (CV = 1.0)

The estimated minimum annual mortality rate incidental to commercial fisheries is 36 harbor seals, based on observer data (4) and self-reported fisheries information (rounded to 32). However, a reliable estimate of the mortality rate incidental to commercial fisheries is currently unavailable because of the absence of observer placements in the gillnet fisheries mentioned above. The Yakutat salmon set gillnet fishery is scheduled to be observed in 2000 and 2001. The Southeast Alaska drift gillnet fishery is scheduled to be observed in 2005 and 2006.

#### **Subsistence/Native Harvest Information**

The 1992-96 subsistence harvest of harbor seals in Alaska was estimated by the Alaska Department of Fish and Game, under contract with NMFS (Table 6b11; Wolfe and Mishler 1993, 1994, 1995, 1996, 1997). In each year, data were collected through systematic interviews with hunters and users of marine mammals in approximately 2,100 households in about 60 coastal communities within the geographic range of the harbor seal in Alaska. Interviews were conducted in 18 communities in Southeast Alaska. The statewide total subsistence take of harbor seals in 1992 was estimated at 2,888 (95% CI 2,320-3,741), with 2,535 harvested and 353 struck and lost. The total subsistence take in 1993 was estimated at 2,736 (95% CI 2,334-3,471), with 2,365 harvested and 371 struck and lost. The total subsistence take in 1994 was estimated at 2,621 (95% CI 2,110-3,457), with 2,313 harvested and 308 struck and lost. The total subsistence take in 1995 was estimated at 2,742 (95% CI 2,184-3,679), with 2,499 harvested and 243 struck and lost. The total subsistence take in 1996 was estimated at 2,741 (95% CI 2,378-3,479), with 2,415 harvested and 327 struck and lost.

Table 6b11 provides a summary of the subsistence harvest information for the Southeast Alaska stock. The mean annual subsistence take from this stock of harbor seals, including struck and lost, over the 3-year period from 1994 to 1996 was 1,749 animals. The reported average age-specific kill of the harvest from the Southeast Alaska stock since 1992 was 85% adults, 7% juveniles, 1% pups, and 7% of unknown age. The reported average sex-specific kill of the harvest was 49% males, 24% females, and 27% of unknown sex.

**Table 6b11.** Summary of the subsistence harvest data for the Southeast Alaska stock of harbor seals, 1992-96.

<b>Year</b>	<b>Estimated total number taken</b>	<b>Percentage of statewide total</b>	<b>Number harvested</b>	<b>Number struck and lost</b>
1992	1,670	58.3%	1,481	189
1993	1,615	59.2%	1,425	190



Year	Estimated total number taken	Percentage of statewide total	Number harvested	Number struck and lost
1994	1,500	57.2%	1,348	152
1995	1,890	68.9%	1,719	171
1996	1,858	67.7%	1,642	216
Mean annual take (1994-96)	1,749			

### Other Mortality

Illegal intentional killing of harbor seals occurs, but the magnitude of this mortality is unknown (Note: the 1994 Amendments to the MMPA made intentional lethal take of any marine mammal illegal except where imminently necessary to protect human life).

### STATUS OF STOCK

Harbor seals are not listed as “depleted” under the MMPA or listed as “threatened” or “endangered” under the Endangered Species Act. A reliable estimate of the annual rate of mortality incidental to commercial fisheries is unavailable. Therefore, it is unknown whether the kill rate is insignificant. At present, annual mortality levels less than 211 animals per year (i.e., 10% of PBR) can be considered insignificant and approaching zero mortality and serious injury rate. Based on currently available data, the estimated annual level of total human-caused mortality is 1,785 (36 + 1,749) harbor seals. Although considered unlikely due to stable or increasing trends, it is unknown if the estimated annual level of total human-caused mortality and serious injury exceeds the PBR (2,114) for this stock. Until additional information on mortality incidental to commercial fisheries becomes available, the Southeast Alaska stock of harbor seals is not classified as strategic. This classification is consistent with the recommendations of the Alaska Scientific Review Group (DeMaster 1995: p. 14). The status of this stock relative to its Optimum Sustainable Population size is unknown.

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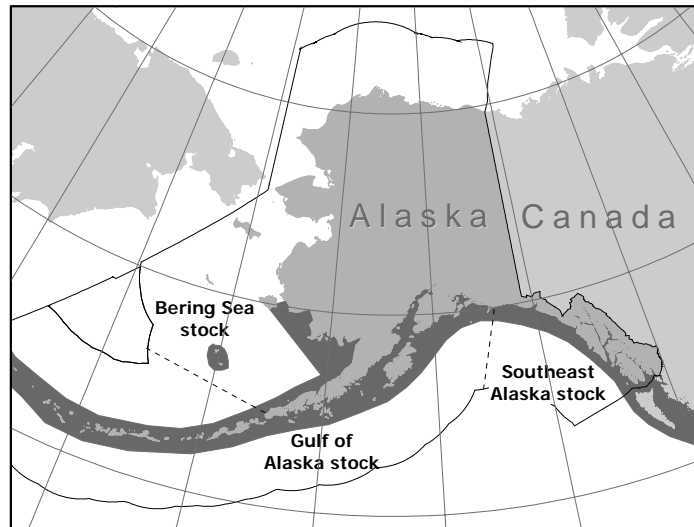
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### HARBOR SEAL (*Phoca vitulina richardsi*): Gulf of Alaska Stock

**NOTE - August 2002:** NMFS has new genetic information on harbor seals in Alaska which indicates that the current boundaries between the Southeast Alaska, Gulf of Alaska, and Bering Sea stocks of harbor seals in Alaska need to be reassessed. NMFS, in cooperation with our partners in the Alaskan Native community, is evaluating the new genetic information and hopes to make a joint recommendation regarding stock structure in 2003. A complete revision of the harbor stock assessments will be postponed until new stocks are defined.

#### STOCK DEFINITION AND GEOGRAPHIC RANGE

Harbor seals inhabit coastal and estuarine waters off Baja California, north along the western coasts of the United States, British Columbia, and Southeast Alaska, west through the Gulf of Alaska and Aleutian Islands, and in the Bering Sea northward to Cape Newenham and the Pribilof Islands. They haul out on rocks, reefs, beaches, and drifting glacial ice, and feed in marine, estuarine, and occasionally fresh waters. Harbor seals generally are non-migratory, with local movements associated with such factors as tides, weather, season, food availability, and reproduction (Scheffer and Slipp 1944; Fisher 1952; Bigg 1969, 1981). The results of recent satellite tagging studies in Southeast Alaska, Prince William Sound, and Kodiak are also consistent with the conclusion that harbor seals are non-migratory (Frost et al. 1996, Swain et al. 1996). However, some long-distance movements of tagged animals in Alaska have been recorded (Pitcher and McAllister 1981, Frost et al. 1996). Strong fidelity of individuals for haulout sites in June and August also has been reported, although these studies considered only limited areas during a relatively short period of time (Pitcher and Calkins 1979, Pitcher and McAllister 1981).



**Figure 69.** Approximate distribution of harbor seals in Alaska waters (shaded area).

The following information was considered in classifying stock structure based on the Dizon et al. (1992) phylogeographic approach: 1) Distributional data: geographic distribution continuous, natal dispersal characteristics unknown, breeding dispersal is presumed to be very limited, year-round site fidelity observed, seasonal movements greater than 300 km rare (Harvey 1987) except in western Alaska (Hoover-Miller 1994); 2) Population response data: substantial differences in population dynamics between Southeast Alaska and the rest of Alaska, and presumed differences between Gulf of Alaska and Bering Sea (Hoover 1988, Hoover-Miller 1994, Withrow and Loughlin 1996); 3) Phenotypic data: clinal variation in body size and color phase (Shaughnessy and Fay 1977, Kelly 1981); 4) Genotypic data: undetermined for Alaska, mitochondrial DNA analyses currently underway. Preliminary genetic data indicate substantial variation in mtDNA suggesting at least two genetically distinct stocks in Alaska (Westlake and O'Corry-Crowe 1997). However, until additional samples are analyzed the Alaska Scientific Review Group (SRG) recommended using the same stock boundaries as in the Stock Assessment Reports for 1996 (Hill et al. 1997).

The Alaska SRG concluded that the scientific data available to support three distinct biological stocks (i.e., genetically isolated populations) were equivocal. However, the Alaska SRG recommended that the available data were sufficient to justify the establishment of three management units for harbor seals in Alaska (DeMaster 1996). Further, the SRG recommended that, unlike the stock structure reported in Small and DeMaster (1995), animals in the Aleutian Islands should be included in the same management unit as animals in the Gulf of Alaska. As noted above, this recommendation has been adopted by NMFS with the caveat that management units and stocks are equivalent for the purposes of managing incidental take under section 118 of the Marine Mammal Protection Act (Wade and Angliss 1997). Therefore, based primarily on the significant population decline of seals in the Gulf of

Alaska, the possible decline in the Bering Sea, and the stable population in Southeast Alaska (see Current Population Trend section in the respective harbor seal report for details), three separate stocks are recognized in Alaska waters: 1) the Southeast Alaska stock - occurring from the Alaska/British Columbia border to Cape Suckling, Alaska (144°W), 2) the Gulf of Alaska stock - occurring from Cape Suckling to Unimak Pass, including animals throughout the Aleutian Islands, and 3) the Bering Sea stock - including all waters north of Unimak Pass (Fig. 89). Information concerning the three harbor seal stocks recognized along the West Coast of the continental United States can be found in the Stock Assessment Reports for the Pacific Region.

## POPULATION SIZE

Extensive photographic aerial surveys of harbor seals from the Gulf of Alaska stock were conducted during 1994 and 1996. The Aleutian Islands were surveyed from 29 August to 8 September of 1994 (Withrow and Loughlin 1995a). Between 25 August and 3 September of 1996 the south side of the Alaska Peninsula, Cook Inlet, Kenai Peninsula, Kodiak Archipelago, and Copper River Delta were surveyed (Withrow and Loughlin 1997). All known harbor seal haulout sites in each area were surveyed, and reconnaissance surveys were flown prior to photographic surveys to establish the location of additional sites. Aerial surveys were flown within 2 hours on either side of low tide, based on the assumption that at locations affected by tides, harbor seals haul out in greatest numbers at and around the time of low tide (Pitcher and Calkins 1979, Calambokidis et al. 1987). One to seven repetitive photographic counts were obtained for each major haulout site within each study area. Coefficients of variation (CV) were determined for multiple surveys and found to be  $<0.19$  in all cases. This method of estimating abundance and its CV assumes that during the survey period no migration occurred between sites and that there was no trend in the number of animals ashore. The number of seals moving between areas was assumed to be small considering each area's large geographic size, though a small number of seals may have been counted twice or not at all.

During summer of 1996, two different aerial surveys covered portions of Prince William Sound. During August 17-26, surveys of trend route A in Prince William Sound resulted in an adjusted mean count of 984 (CV = 0.045) seals (Frost et al. 1997). Between August 27 and September 6, surveys of trend route B, excluding Columbia Bay (a tidewater glacial haulout system), in Prince William Sound resulted in a mean count of 1,261 (CV = 0.044) seals (unpubl. data, J. Burns, Living Resources Inc., P. O. Box 83570, Fairbanks, AK, 99708). During the route B surveys, the count data from Columbia Bay were considered unreliable due to difficult ice conditions and the widely scattered distribution of seals. Instead, a reasonable minimum estimate for the number of harbor seals using Columbia Bay at the time of the surveys (1,000 seals) will be added below (see Minimum Population Estimate section). Combining the counts from trend routes A and B results in a mean count of 2,245 (CV = 0.032) harbor seals in Prince William Sound, excluding Columbia Bay.

Due to the extreme difficulty in censusing harbor seals during the 1994 Aleutian Islands survey, it is recommended that the maximum count of 3,437 be used for an abundance estimate for that region (Withrow and Loughlin 1995a). The coefficient of variation for the mean count (CV = 0.059) should be used for the 1994 survey data because an estimate for the CV is not available for the maximum count. The mean count for the 1996 surveys was 16,013 (CV = 0.025) harbor seals, with the following mean counts for the major survey areas: Copper River Delta 3,174 (CV = 0.078); Prince William Sound 2,245; Kenai Peninsula 713 (CV = 0.072); Cook Inlet 2,244 (CV = 0.105); Kodiak Archipelago 4,437 (CV = 0.035); and the south side of the Alaska Peninsula 3,200 (CV = 0.034). Therefore, for the Gulf of Alaska stock of harbor seals, the total combined count from the 1994 and 1996 aerial surveys was 19,450 (CV = 0.023) animals.

Data collected from 36 tagged harbor seals in Southeast Alaska during 1994 resulted in a correction factor of 1.74 (CV = 0.068) to account for animals in the water which are thus missed during the aerial surveys (Withrow and Loughlin 1995b). In 1995, 25 harbor seals were tagged at a sand bar haulout near Cordova, AK (note: within the Gulf of Alaska). The haulout behavior of these seals was monitored from August 12 to 23, and a correction factor of 1.50 (CV = 0.047) was developed for the 1995 aerial survey in this area (Withrow and Loughlin 1996). Although much of the haulout substrate in the Gulf of Alaska area is rocky, the 1.50 CF (correction factor) from 1995 is considered to be the best available and most conservative CF for the 1996 survey data because the data used to estimate the CF were 1) collected in the survey area, 2) collected during a comparable low-tide survey window, and 3) collected more closely to the peak haul out time period (i.e., CF data collected from 12 August to 23 August versus the survey data from 23 August to 9 September). The Southeast Alaska correction factor of 1.74 was not employed for this stock because the data used to calculate the CF were 1) not collected from the Gulf of Alaska area and 2) collected to some extent after the survey period was completed (i.e., CF data from SE Alaska were collected from 1 September to 11 September)(Alaska SRG, see DeMaster 1996). Therefore, using the Gulf of Alaska

correction factor results in an abundance estimate of 29,175 ( $19,450 \times 1.50$ ,  $CV = 0.052$ ) for the Gulf of Alaska stock of harbor seals.

The next round of aerial surveys to assess the abundance of this stock will occur during the summers of 1999 (Aleutian Islands) and 2001 (Gulf of Alaska). Preliminary results of these surveys will be available in autumn of the respective survey year.

### **Minimum Population Estimate**

The minimum population estimate ( $N_{MIN}$ ) for this stock is calculated using Equation 1 from the PBR Guidelines (Wade and Angliss 1997):  $N_{MIN} = N / \exp(0.842 \times [\ln(1 + [CV(N)]^2)]^{1/2})$ . Using the population estimate ( $N$ ) of 29,175 and its associated  $CV(N)$  of 0.052,  $N_{MIN}$  for this stock of harbor seals is 27,917. Including the minimum population estimate for Columbia Bay (1,000 animals) results in an  $N_{MIN}$  of 28,917 harbor seals for the Gulf of Alaska stock.

### **Current Population Trend**

The population trend in the Aleutian Islands is unclear because the 1994 survey was the most complete census to date for that region. Previous harbor seal counts in that area are not comparable to the 1994 data because they were conducted incidental to surveys designed to assess other species (i.e., sea otters or Steller sea lions). However, a subset of the 1994 survey in the eastern Aleutian Islands indicated a count of 1,600 in an area that had counts of approximately 1,000-2,500 seals during 1975-77 (Small 1996).

In Prince William Sound, harbor seal numbers declined by 57% from 1984 to 1992 (Pitcher 1989, Frost and Lowry 1993). The decline began before the 1989 *Exxon Valdez* oil spill, was greatest in the year of the spill, and may have lessened thereafter. Between 1989 and 1995, aerial survey counts of 25 haulout sites in Prince William Sound (trend route A) showed significant declines in the number of seals during the molt (19%) and during pupping (31%) (Frost et al. 1996). Adjusted molt period counts for 1996 were 15% lower than the 1995 counts, indicating that harbor seal numbers in Prince William Sound have not yet recovered from the spill or whatever was causing the decline and that the long-term decline has not ended (Frost et al. 1997).

A steady decrease in numbers of harbor seals has been reported throughout the Kodiak Archipelago from the mid-1970s to the 1990s. On southwestern Tugidak Island, formally one of the largest concentrations of harbor seals in the world, counts declined 85% from 1976 (6,919) to 1988 (1,014) (Pitcher 1990). More recently, the Tugidak Island count has increased from 769 in 1992 to 1,420 in 1996 (Small 1996, Withrow and Loughlin 1997), although this still only represents a fraction of its historical size. The population around Kodiak Island, based on an aerial photographic route established in 1992, is estimated to have increased at 7.2% annually from 1992-96 (Small et al. 1997). Despite some positive signs of growth in certain areas, the overall Gulf of Alaska stock size remains small compared to its size in the 1970s and 1980s.

### **CURRENT AND MAXIMUM NET PRODUCTIVITY RATES**

Reliable rates of maximum net productivity have not been estimated for the Gulf of Alaska or Bering Sea harbor seal stock. Population growth rates were estimated at 6% and 8% between 1991 and 1992 in Oregon and Washington, respectively (Huber et al. 1994). Harbor seals have been protected in British Columbia since 1970, and the population has responded with an annual rate of increase of approximately 12.5% since 1973 (Olesiuk et al. 1990). However, until additional data become available from which more reliable estimates of population growth can be determined, it is recommended that the pinniped maximum theoretical net productivity rate ( $R_{MAX}$ ) of 12% be employed for this stock (Wade and Angliss 1997).

### **POTENTIAL BIOLOGICAL REMOVAL**

Under the 1994 reauthorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor:  $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$ . The recovery factor ( $F_R$ ) for this stock is 0.5, the value for pinniped stocks with unknown status (Wade and Angliss 1997). Thus, for the Gulf of Alaska stock of harbor seals,  $PBR = 868$  animals ( $28,917 \times 0.06 \times 0.5$ ).



## ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

### Fisheries Information

Three different commercial fisheries operating within the range of the Gulf of Alaska stock of harbor seals were monitored for incidental take by fishery observers during 1990-96: Gulf of Alaska groundfish trawl, longline, and pot fisheries. For the fisheries with observed takes, the range of observer coverage over the 7-year period, as well as the annual observed and estimated mortalities are presented in Table 7a12. The mean annual (total) mortality rate was 0.4 (CV = 1.0) for the Gulf of Alaska groundfish trawl fishery and was 0.2 (CV = 1.0) Gulf of Alaska pot fishery. The harbor seal taken in the pot fishery in 1995 (7% observer coverage) occurred during an unmonitored haul and therefore could not be used to estimate mortality for the entire fishery. Therefore, 1 mortality was used as both the observed mortality and estimated mortality in 1995 for that fishery, and should be considered a minimum estimate.

**Table 7a12.** Summary of incidental mortality of harbor seals (Gulf of Alaska stock) due to commercial fisheries from 1990 through 1996 and calculation of the mean annual mortality rate. Mean annual mortality in brackets represents a minimum estimate from self-reported fisheries information or stranding data. Data from 1992 to 1996 (or the most recent 5 years of available data) are used in the mortality calculation when more than 5 years of data are provided for a particular fishery. n/a indicates that data are not available.

Fishery name	Years	Data type	Range of observer coverage	Observed mortality (in given yrs.)	Estimated mortality (in given yrs.)	Mean annual mortality
Gulf of Alaska (GOA) groundfish trawl	90-96	obs data	33-55%	0, 1, 1, 0, 0, 0, 0	0, 3, 2, 0, 0, 0, 0	0.4 (CV = 1.0)
GOA finfish pot	90-96	obs data	5-13%	0, 0, 0, 0, 0, 1, 0	0, 0, 0, 0, 0, 1, 0	0.2 (CV = 1.0)
Prince William Sound salmon drift gillnet	90-91	obs data	4-5%	2, 1	36, 12	24 (CV = 0.50)
Alaska Peninsula/Aleutian Islands salmon drift gillnet	90	obs data	4%	0	0	0
Observer program total						24.6 (CV = 0.49)
				<b>Reported mortalities</b>		
Cook Inlet salmon set gillnet	90-96	self reports	n/a	6, 0, 1, 0, n/a, n/a, n/a	n/a	[≥1.75]
Prince William Sound set gillnet	90-96	self reports	n/a	0, 0, 0, 1, n/a, n/a, n/a	n/a	[≥0.25]
Kodiak salmon set gillnet	90-96	self reports	n/a	3, 0, 0, 0, n/a, n/a, n/a	n/a	[≥0.75]
Alaska salmon purse seine (except for Southeast)	90-96	self reports	n/a	0, 0, 0, 2, n/a, n/a, n/a	n/a	[≥0.5]
Alaska Peninsula/Aleutian Islands salmon drift gillnet	90-96	self reports	n/a	9, 2, 12, 5, n/a, n/a, n/a	n/a	[≥7.0]
unknown Gulf of Alaska fishery	92-96	strand data	n/a	0, 0, 0, 0, 1	n/a	[≥0.2]
Minimum total annual mortality						≥35.05 (CV = 0.49)

In the Prince William Sound salmon drift gillnet fishery, observers recorded 2 incidental mortalities of harbor seals in 1990 (Wynne et al. 1991), and 1 in 1991 (Wynne et al. 1992). The extrapolated kill estimates were 36 (95% CI 2-74) in 1990 and 12 (95% CI 1-44) in 1991, resulting in a mean kill rate of 24 (CV = 0.5) animals per year for this fishery. In 1990, observers boarded 300 (57.3%) of the 524 vessels that fished in the Prince William Sound salmon drift gillnet fishery, monitoring a total of 3,166 sets, or roughly 4% of the estimated number of sets made by the fleet. In 1991, observers boarded 531 (86.9%) of the 611 registered vessels and monitored a total of

5,875 sets, or roughly 5% of the estimated sets made by the fleet. The estimated mortality rate of harbor seals based on the 1990 and 1991 observed mortalities for this fishery is 0.0002 kills per set. Fisher self-reports of harbor seal mortalities due to this fishery detail 19, 4, 7, 24, and 0 mortalities in 1990, 1991, 1992, 1993, and 1996, respectively. The extrapolated (estimated) mortality from the 1990-91 observer program (24 seals per year) accounts for these mortalities, so they do not appear in Table 7a12. Combining the estimates from the groundfish trawl and pot fisheries presented above ( $0.4 + 0.2 = 0.6$ ) with the estimate from the Prince William Sound salmon drift gillnet fishery (24) results in an estimated annual incidental kill rate in observed fisheries of 24.6 (CV = 0.49) harbor seals per year from this stock. It should be noted that in 1990, observers also boarded 59 (38.3%) of the 154 vessels participating in the Alaska Peninsula/Aleutian Island salmon drift gillnet fishery, monitoring a total of 373 sets, or roughly 4% of the estimated number of sets made by the fleet (Wynne et al. 1991). Although no interaction with harbor seals was recorded by observers in 1990, due in part to the low level of observer coverage, mortalities did occur as recorded in fisher self-reports (see Table 7a12).

An additional source of information on the number of harbor seals killed or injured incidental to commercial fishery operations is the self-reported fisheries information required of vessel operators by the MMPA. During the period between 1990 and 1996, fisher self-reports from 5 unobserved fisheries (see Table 7a12) resulted in an annual mean of 10.25 mortalities from interactions with commercial fishing gear. However, because logbook records (fisher self-reports required during 1990-94) are most likely negatively biased (Credle et al. 1994), these are considered to be minimum estimates. These totals are based on all available self-reported fisheries information for Gulf of Alaska fisheries, except the Prince William Sound salmon drift gillnet fishery and the Gulf of Alaska groundfish trawl and pot fisheries for which observer data were presented above. In 1990, fisher self-reports from the Cook Inlet set and drift gillnet fisheries were combined. As a result, some of the harbor seal mortalities reported in 1990 may have occurred in the drift net fishery. Self-reported fisheries data are incomplete for 1994, not available for 1995, and considered unreliable for 1996 (see Appendix 7 for details).

Strandings of harbor seals entangled in fishing gear or with injuries caused by interactions with gear are another source of mortality data. During the 5-year period from 1992 to 1996 the only fishery-related harbor seal stranding was reported in June of 1996 on Middleton Island. The entanglement could not be attributed to a particular fishery and as a result has been included in Table 7a12 as occurring in an unknown fishery. Fishery-related strandings during 1992-96 result in an estimated annual mortality of 0.2 harbor seals from this stock. This estimate is considered a minimum because not all entangled animals strand and not all stranded animals are found or reported.

The estimated minimum annual mortality rate incidental to commercial fisheries is 36 (rounded up), based on observer data (24.6) and self-reported fisheries information (10.25) or stranding data (0.2) where observer data were not available. However, a reliable estimate of the mortality rate incidental to commercial fisheries is currently unavailable because of the absence of observer placements in several fisheries mentioned above.

### **Subsistence/Native Harvest Information**

The 1992-96 subsistence harvest of harbor seals in Alaska was estimated by the Alaska Department of Fish and Game, under contract with the NMFS (Table 7b13: Wolfe and Mishler 1993, 1994, 1995, 1996, 1997). In each year, data were collected through systematic interviews with hunters and users of marine mammals in approximately 2,100 households in about 60 coastal communities within the geographic range of the harbor seal in Alaska. Between 1992-96, interviews were conducted in approximately 29 communities that lie within the range of the Gulf of Alaska harbor seal stock. The statewide total subsistence take of harbor seals in 1992 was estimated at 2,888 (95% CI 2,320-3,741), with 2,535 harvested and 353 struck and lost. The total subsistence take in 1993 was estimated at 2,736 (95% CI 2,334-3,471), with 2,365 harvested and 371 struck and lost. The total subsistence take in 1994 was estimated at 2,621 (95% CI 2,110-3,457), with 2,313 harvested and 308 struck and lost. The total subsistence take in 1995 was estimated at 2,742 (95% CI 2,184-3,679), with 2,499 harvested and 243 struck and lost. The total subsistence take in 1996 was estimated at 2,741 (95% CI 2,378-3,479), with 2,415 harvested and 327 struck and lost.

Table 7b13 provides a summary of the subsistence harvest information for the Gulf of Alaska stock. The mean annual subsistence take from this stock of harbor seals, including struck and lost, over the 3-year period from 1994 to 1996 was 791 animals. The reported average age-specific kill of the harvest from the Gulf of Alaska stock since 1992 was 58% adults, 27% juveniles, 2% pups, and 13% of unknown age. The reported average sex-specific kill of the harvest was 44% males, 18% females, and 38% of unknown sex.

**Table 7b13.** Summary of the subsistence harvest data for the Gulf of Alaska stock of harbor seals, 1992-96.

Year	Estimated total number taken	Percentage of statewide total	Number harvested	Number struck and lost
1992	967	33.7%	884	83
1993	914	33.5%	812	102
1994	913	34.9%	819	94
1995	724	26.4%	683	41
1996	735	26.8%	679	56
Mean annual take (1994-96)	791			

### Other Mortality

Illegal intentional killing of harbor seals occurs, but the magnitude of this mortality is unknown (Note: the 1994 Amendments to the MMPA made intentional lethal take of any marine mammal illegal except where imminently necessary to protect human life).

### STATUS OF STOCK

Sustainable harvest levels for this stock will be determined from the analysis of information gathered through the cooperative management process, and will reflect the degree of uncertainty associated with the information obtained for this stock. Efforts were initiated in 1995 and 1996 to develop a cooperative approach for management of this stock; a final agreement was approved in 1999.

Harbor seals are not listed as “depleted” under the MMPA or listed as “threatened” or “endangered” under the Endangered Species Act. A reliable estimate of the annual rate of mortality incidental to commercial fisheries is unavailable. Therefore, it is unknown whether the kill rate due to commercial fishing is insignificant. At present, annual fishery-related mortality levels less than 87 animals per year (i.e., 10% of PBR) can be considered insignificant and approaching zero mortality and serious injury rate. Based on currently available data, the estimated annual level of total human-caused mortality is 827 (36 + 791) harbor seals which does not exceed the PBR (868) for this stock. Until additional information on mortality incidental to commercial fisheries becomes available, the Gulf of Alaska stock of harbor seals is not classified as strategic. This classification is consistent with the recommendations of the Alaska SRG (DeMaster 1998). The status of this stock relative to its Optimum Sustainable Population size is unknown.

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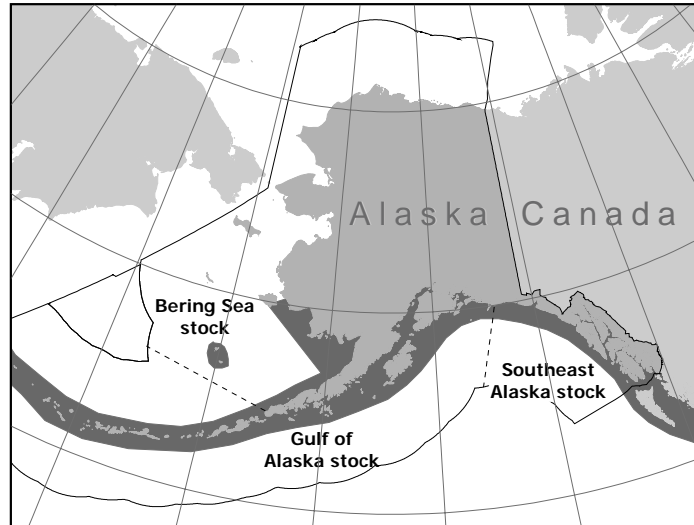


### HARBOR SEAL (*Phoca vitulina richardsi*): Bering Sea Stock

**NOTE - August 2002:** NMFS has new genetic information on harbor seals in Alaska which indicates that the current boundaries between the Southeast Alaska, Gulf of Alaska, and Bering Sea stocks of harbor seals in Alaska need to be reassessed. NMFS, in cooperation with our partners in the Alaskan Native community, is evaluating the new genetic information and hopes to make a joint recommendation regarding stock structure in 2003. A complete revision of the harbor stock assessments will be postponed until new stocks are defined.

#### STOCK DEFINITION AND GEOGRAPHIC RANGE

Harbor seals inhabit coastal and estuarine waters off Baja California, north along the western coasts of the United States, British Columbia, and Southeast Alaska, west through the Gulf of Alaska and Aleutian Islands, and in the Bering Sea north to Cape Newenham and the Pribilof Islands. They haul out on rocks, reefs, beaches, and drifting glacial ice, and feed in marine, estuarine, and occasionally fresh waters. Harbor seals generally are non-migratory, with local movements associated with such factors as tides, weather, season, food availability, and reproduction (Scheffer and Slipp 1944; Fisher 1952; Bigg 1969, 1981). The results of recent satellite tagging studies in Southeast Alaska, Prince William Sound, and Kodiak are also consistent with the conclusion that harbor seals are non-migratory (Frost et al. 1996, Swain et al. 1996). However, some long-distance movements of tagged animals in Alaska have been recorded (Pitcher and McAllister 1981, Frost et al. 1996). Strong fidelity of individuals for haulout sites in June and August also has been reported, although these studies considered only limited areas during a relatively short period of time (Pitcher and Calkins 1979, Pitcher and McAllister 1981).



**Figure 710.** Approximate distribution of harbor seals in Alaska waters (shaded area).

The following information was considered in classifying stock structure based on the Dizon et al. (1992) phylogeographic approach: 1) Distributional data: geographic distribution continuous, natal dispersal characteristics unknown, breeding dispersal is presumed to be very limited, year-round site fidelity observed, seasonal movements greater than 300 km rare (Harvey 1987) except in western Alaska (Hoover-Miller 1994); 2) Population response data: substantial differences in population dynamics between Southeast Alaska and the rest of Alaska, and presumed differences between Gulf of Alaska and Bering Sea (Hoover 1988, Hoover-Miller 1994, Withrow and Loughlin 1996b); 3) Phenotypic data: clinal variation in body size and color phase (Shaughnessy and Fay 1977, Kelly 1981); 4) Genotypic data: undetermined for Alaska, mitochondrial DNA analyses currently underway. Preliminary genetic data indicate substantial variation in mtDNA suggesting at least two genetically distinct stocks in Alaska (Westlake and O'Corry-Crowe 1997). However, until additional samples are analyzed the Alaska Scientific Review Group (SRG) recommended using the same stock boundaries as in the Stock Assessment Reports for 1996 (Hill et al. 1997).

The Alaska SRG concluded that the scientific data available to support three distinct biological stocks (i.e., genetically isolated populations) were equivocal. However, the Alaska SRG recommended that the available data were sufficient to justify the establishment of three management units for harbor seals in Alaska (DeMaster 1996). Further, the SRG recommended that, unlike the stock structure reported in Small and DeMaster (1995), animals in the Aleutian Islands should be included in the same management unit as animals in the Gulf of Alaska. As noted above, this recommendation has been adopted by NMFS with the caveat that management units and stocks are equivalent for the purposes of managing incidental take under section 118 of the Marine Mammal Protection Act (Wade and Angliss 1997). Therefore, based primarily on the significant population decline of seals in the Gulf of



Alaska, the possible decline in the Bering Sea, and the stable population in Southeast Alaska (see Current Population Trend section in the respective harbor seal report for details), three separate stocks are recognized in Alaska waters: 1) the Southeast Alaska stock - occurring from the Alaska/British Columbia border to Cape Suckling, Alaska (144°W), 2) the Gulf of Alaska stock - occurring from Cape Suckling to Unimak Pass, including animals throughout the Aleutian Islands, and 3) the Bering Sea stock - including all waters north of Unimak Pass (Fig. 9<sup>10</sup>). Information concerning the three harbor seal stocks recognized along the West Coast of the continental United States can be found in the Stock Assessment Reports for the Pacific Region.

## POPULATION SIZE

Extensive photographic aerial surveys of harbor seals in the Bering Sea were conducted during the autumn molt in 1995 (28 August - 10 September), throughout northern Bristol Bay and along the north side of the Alaska Peninsula (Withrow and Loughlin 1996a). All known harbor seal haulout sites in each area were surveyed, and reconnaissance surveys were flown prior to photographic surveys to establish the location of additional sites. Aerial surveys were flown within 2 hours on either side of low tide, based on the assumption that at locations affected by tides, harbor seals haul out in greatest numbers at and around the time of low tide (Pitcher and Calkins 1979, Calambokidis et al. 1987). At least four repetitive photographic counts were obtained for each major rookery and haulout site within each study area. Coefficients of variation were determined for multiple surveys and found to be <0.19 in all cases. This method of estimating abundance and its CV assumes that during the survey period no migration occurred between sites and that there was no trend in the number of animals ashore. The number of seals moving between areas was assumed to be small considering each area's large geographic size, though a small number of seals may have been counted twice or not at all.

The total mean count for the 1995 surveys was 8,740 (CV = 0.040) harbor seals, with mean counts of 955 (CV = 0.071) for northern Bristol Bay and 7,785 (CV = 0.044) for the north side of the Alaska Peninsula (Withrow and Loughlin 1996a). A correction factor based on data from animals from this stock is currently unavailable. A tagging experiment conducted from 17 to 23 August 1995 collected data from 25 harbor seals using a sand bar haul out near Cordova, Alaska (within the Gulf of Alaska), resulting in a correction factor of 1.50 (CV = 0.047) to account for animals in the water which are thus missed during the aerial surveys (Withrow and Loughlin 1996b). This correction factor was used for the Bering Sea stock due to the similarity in haulout habitat type (sand bar) to a majority of harbor seal haulout sites found in the Bering Sea. Further, this CF was considered conservative by the Alaska SRG (DeMaster 1996) because the timing of the aerial survey was later than the timing of the CF study and it is likely that the fraction of seals hauled out during the surveys was smaller. Multiplying these aerial survey counts by the correction factor results in an estimated abundance of 13,110 ( $8,740 \times 1.50$ ; CV = 0.062) harbor seals.

In 1995, daily land counts of harbor seals were conducted on Otter Island (one of the Pribilof Islands) from July 2 through August 8. The maximum count during this study was 202 seals (Withrow and Loughlin 1996a). Adding this count to the corrected estimated abundance from the aerial surveys results in an estimated abundance of 13,312 ( $13,110 + 202$ ) harbor seals for the Bering Sea stock.

## Minimum Population Estimate

The minimum population estimate ( $N_{\text{MIN}}$ ) for this stock is calculated using Equation 1 from the PBR Guidelines (Wade and Angliss 1997):  $N_{\text{MIN}} = N / \exp(0.842 \times [\ln(1 + [\text{CV}(N)]^2)]^{1/2})$ . Using the population estimate (N) of 13,110 from the aerial surveys and the associated CV(N) of 0.062, results in an estimate of 12,446 harbor seals. Adding the maximum count of 202 seals from the Otter Island survey results in an  $N_{\text{MIN}}$  of 12,648 for the Bering Sea harbor seal stock.

## Current Population Trend

The number of harbor seals in the Bering Sea stock is thought to have declined between the 1980s and 1990s (Alaska SRG, see DeMaster 1996); however, published data to support this conclusion are unavailable. Specifically, in 1974 there were 1,175 seals reported on Otter Island. The maximum count in 1995 (202 seals) represents an 83% decline (Withrow and Loughlin 1996a). However, as noted by the Alaska SRG (DeMaster 1996), the reason(s) for this decline is(are) confounded by the recolonization of Otter Island by northern fur seals since 1974, which has caused a loss of available habitat for harbor seals. Further, counts of harbor seals on the north side of the Alaska Peninsula in 1995 were less than 42% of the 1975 counts, representing a decline of 3.5% per year. The number of harbor seals in northern Bristol Bay are also lower, but have remained stable since 1990 (Withrow and Loughlin 1996a).

## CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Reliable rates of maximum net productivity have not been estimated for the Gulf of Alaska or Bering Sea stock of harbor seal. Population growth rates were estimated at 6% and 8% between 1991 and 1992 in Oregon and Washington, respectively (Huber et al. 1994). Harbor seals have been protected in British Columbia since 1970, and the population has responded with an annual rate of increase of approximately 12.5% since 1973 (Olesiuk et al. 1990). However, until additional data become available from which more reliable estimates of population growth can be determined, it is recommended that the pinniped maximum theoretical net productivity rate ( $R_{MAX}$ ) of 12% be employed for this stock (Wade and Angliss 1997).

## POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 reauthorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor:  $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$ . The recovery factor ( $F_R$ ) for this stock is 0.5, the value for pinniped stocks with unknown population status (Wade and Angliss 1997). Thus, for the Bering Sea harbor seal stock,  $PBR = 379$  animals ( $12,648 \times 0.06 \times 0.5$ ).

## ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

### Fisheries Information

Three different commercial fisheries operating within the range of the Bering Sea stock of harbor seals were monitored for incidental take by fishery observers during 1990-96: Bering Sea (and Aleutian Islands) groundfish trawl, longline, and pot fisheries. Harbor seal mortality was observed in all three fisheries at low levels. The range of observer coverage over the period, as well as the annual observed and estimated mortalities are presented in Table 8a14. The mean annual (total) mortality rate was 2.2 (CV = 0.44) for the Bering Sea groundfish trawl fishery, 0.6 (CV = 1.0) for the Bering Sea longline fishery, and 1.2 (CV = 0.81) for the Bering Sea pot fishery. The harbor seal taken in the pot fishery in 1992 (34% observer coverage) occurred during an unmonitored haul and therefore could not be used to estimate mortality for the entire fishery. Therefore, 1 mortality was used as both the observed mortality and estimated mortality in 1992 for that fishery, and should be considered a minimum estimate. Combining the estimates from the Bering Sea groundfish trawl, longline, and pot fisheries presented above ( $2.2 + 0.6 + 1.2 = 4.0$ ) results in an estimated annual incidental kill rate in observed fisheries of 4.0 (CV = 0.37) harbor seals per year from the Bering Sea stock.

An additional source of information on the number of harbor seals killed or injured incidental to commercial fishery operations is the self-reported fisheries information required of vessel operators by the MMPA. During the period between 1990 and 1996, fisher self-reports from the Bristol Bay salmon drift and set gillnet fisheries (see Table 8a14) resulted in an annual mean of 26.75 mortalities from interactions with commercial fishing gear. However, because logbook records (fisher self-reports required during 1990-94) are most likely negatively biased (Credle et al. 1994), these are considered to be minimum estimates. These totals are based on all available self-reported fisheries information for Bering Sea fisheries, except the groundfish trawl, longline and pot fisheries for which observer data were presented above. In 1990, fisher self-reports from the Bristol Bay set and drift gillnet fisheries were combined. As a result, some of the harbor seal mortalities reported in 1990 may have occurred in the set net fishery. Self-reported fisheries data are incomplete for 1994, not available for 1995, and considered unreliable for 1996 (see Appendix 7 for details).

The estimated minimum annual mortality rate incidental to commercial fisheries is 31, based on observer data (4) and self-reported fisheries information (27) where observer data were not available. However, a reliable estimate of the mortality rate incidental to commercial fisheries is currently unavailable because of the absence of observer placements in the gillnet fisheries mentioned above. The Bristol Bay salmon set and drift gillnet fisheries are scheduled to be observed in 2005 and 2006.

**Table 8a14.** Summary of incidental mortality of harbor seals (Bering Sea stock) due to commercial fisheries from 1990 through 1996 and calculation of the mean annual mortality rate. Mean annual mortality in brackets represents a minimum estimate from self-reported fisheries information. Data from 1992 to 1996 (or the most recent 5 years of available data) are used in the mortality calculation when more than 5 years of data are provided for a particular fishery. n/a indicates that data are not available.

<b>Fishery name</b>	<b>Years</b>	<b>Data type</b>	<b>Range of observer coverage</b>	<b>Observed mortality (in given yrs.)</b>	<b>Estimated mortality (in given yrs.)</b>	<b>Mean annual mortality</b>
Bering Sea/Aleutian Is. (BSAI) groundfish trawl	90-96	obs data	53-74%	1, 1, 2, 0, 3, 0, 2	1, 1, 3, 0, 5, 0, 3	2.2 (CV = 0.44)
BSAI groundfish longline (incl. misc. finfish and sablefish fisheries)	90-96	obs data	27-80%	0, 0, 0, 1, 0, 0, 0	0, 0, 0, 3, 0, 0, 0	0.6 (CV = 1.0)
BSAI finfish pot	90-96	obs data	17-43%	0, 0, 1, 0, 0, 1, 0	0, 0, 1, 0, 0, 5, 0	1.2 (CV = 0.81)
Observer program total						4.0 (CV = 0.37)
				<b>Reported mortalities</b>		
Bristol Bay salmon drift gillnet	90-96	self reports	n/a	38, 23, 2, 42, n/a, n/a, n/a	n/a	[≥26.25]
Bristol Bay salmon set gillnet	90-96	self reports	n/a	0, 0, 1, 1, n/a, n/a, n/a	n/a	[≥0.5]
Minimum total annual mortality						≥30.75 (CV = 0.37)

#### **Subsistence/Native Harvest Information**

The 1992-96 subsistence harvest of harbor seals in Alaska was estimated by the Alaska Department of Fish and Game, under contract with the NMFS (Table 8b15: Wolfe and Mishler 1993, 1994, 1995, 1996, 1997). In each year, data were collected through systematic interviews with hunters and users of marine mammals in approximately 2,100 households in about 60 coastal communities within the geographic range of the harbor seal in Alaska. Between 1992-96, interviews were conducted in approximately 14 communities that lie within the range of the Bering Sea harbor seal stock. The statewide total subsistence take of harbor seals in 1992 was estimated at 2,888 (95% CI 2,320-3,741), with 2,535 harvested and 353 struck and lost. The total subsistence take in 1993 was estimated at 2,736 (95% CI 2,334-3,471), with 2,365 harvested and 371 struck and lost. The total subsistence take in 1994 was estimated at 2,621 (95% CI 2,110-3,457), with 2,313 harvested and 308 struck and lost. The total subsistence take in 1995 was estimated at 2,742 (95% CI 2,184-3,679), with 2,499 harvested and 243 struck and lost. The total subsistence take in 1996 was estimated at 2,741 (95% CI 2,378-3,479), with 2,415 harvested and 327 struck and lost.

Table 8b15 provides a summary of the subsistence harvest information for the Bering Sea stock. The mean annual subsistence take from this stock of harbor seals, including struck and lost, over the 3-year period from 1994 to 1996 was 161 animals. The reported average age-specific kill of the harvest from the Bering Sea stock since 1992 was 69% adults, 14% juveniles, 4% pups, and 13% of unknown age. The reported average sex-specific kill of the harvest was 25% males, 8% females, and 67% of unknown sex.

#### **Other Mortality**

Illegal intentional killing of harbor seals occurs, but the magnitude of this mortality is unknown (Note: the 1994 Amendments to the MMPA made intentional lethal take of any marine mammal illegal except where imminently necessary to protect human life).

**Table 8b15.** Summary of the subsistence harvest data for the Bering Sea stock of harbor seals, 1992-96.

Year	Estimated total number taken	Percentage of statewide total	Number harvested	Number struck and lost
1992	229	8.0%	160	59
1993	199	7.3%	122	77
1994	208	7.9%	145	63
1995	127	4.6%	97	30
1996	148	5.4%	94	54
Mean annual take (1994-96)	161			

## STATUS OF STOCK

Harbor seals are not listed as “depleted” under the MMPA or listed as “threatened” or “endangered” under the Endangered Species Act. A reliable estimate of the annual rate of mortality incidental to commercial fisheries is unavailable. Therefore, it is unknown whether the kill rate due to commercial fishing is insignificant. At present, annual mortality levels less than 38 animals per year (i.e., 10% of PBR) can be considered insignificant and approaching zero mortality and serious injury rate. Based on the best scientific information available, the estimated level of human-caused mortality and serious injury ( $31 + 161 = 192$ ) is not known to exceed the PBR (379). Therefore, the Bering Sea stock of harbor seals is not classified as a strategic stock. The status of this stock relative to its Optimum Sustainable Population size is unknown.

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## SPOTTED SEAL (*Phoca largha*): Alaska Stock

### STOCK DEFINITION AND GEOGRAPHIC RANGE

Spotted seals are distributed along the continental shelf of the Beaufort, Chukchi, Bering, and Okhotsk Seas south to the northern Yellow Sea and western Sea of Japan (Shaughnessy and Fay 1977, Fig. 4011). Satellite tagging studies have recently provided considerable insight into the seasonal movements of spotted seals (Lowry et al. 1998, Lowry et al. 2000). These studies indicate that spotted seals migrate south from the Chukchi Sea in October and pass through the Bering Strait in November (Lowry et al. 1998). Seals overwinter in the Bering Sea along the ice edge and make rapid east-west movements along the edge (Lowry et al. 1998). During spring they tend to prefer small floes (i.e., < 20 m in diameter), and inhabit mainly the southern margin of the ice, with movement to coastal habitats after the retreat of the sea ice (Fay 1974, Shaughnessy and Fay 1977, Simpkins et al. 2003). In summer and fall, spotted seals use coastal haulouts regularly, and may be found as far north as 69-72°N in the Chukchi and Beaufort Seas (Porsild 1945, Shaughnessy and Fay 1977). To the south, along the west coast of Alaska, spotted seals are known to occur around the Pribilof Islands, Bristol Bay, and the eastern Aleutian Islands. Of 8 known breeding areas, 3 occur in the Bering Sea, with the remaining 5 in the Okhotsk Sea and Sea of Japan. There is little morphological difference between seals from these areas. Spotted seals are closely related to and often mistaken for North-Pacific harbor seals (*Phoca vitulina richardsi*). The 2 species are often seen together and are partially sympatric, as their ranges overlap in the southern part of the Bering Sea (Quakenbush 1988). Yet, spotted seals breed earlier and are less social during the breeding season, and only spotted seals are regularly strongly associated with pack ice (Shaughnessy and Fay 1977). These and other ecological, behavioral, genetic, and morphological differences support their recognition as two separate species (Quakenbush 1988).



**Figure 4011.** Approximate distribution of spotted seals in Alaska waters (shaded area).

The following information was considered in classifying stock structure based on the Dizon et al. (1992) phylogeographic approach: 1) Distributional data: geographic distribution continuous; 2) Population response data: unknown; 3) Phenotypic data: unknown; 4) Genotypic data: unknown. Based on this limited information, and the absence of any significant fishery interactions, there is currently no strong evidence to suggest splitting the distribution of spotted seals into more than one stock. Therefore, only the Alaska stock is recognized in U.S. waters.

The following information was considered in classifying stock structure based on the Dizon et al. (1992) phylogeographic approach: 1) Distributional data: geographic distribution continuous; 2) Population response data: unknown; 3) Phenotypic data: unknown; 4) Genotypic data: unknown. Based on this limited information, and the absence of any significant fishery interactions, there is currently no strong evidence to suggest splitting the distribution of spotted seals into more than one stock. Therefore, only the Alaska stock is recognized in U.S. waters.

### POPULATION SIZE

A reliable estimate of spotted seal population abundance is currently not available (Rugh et al. 1995). However, early estimates of the world population were in the range of 335,000-450,000 animals (Burns 1973). The population of the Bering Sea, including Russian waters, was estimated to be 200,000-250,000 based on the distribution of family groups on ice during the mating season (Burns 1973). Fedoseev (1971) estimated 168,000 seals in the Okhotsk Sea. Aerial surveys were flown in 1992 and 1993 to examine the distribution and abundance of spotted seals in Alaska. In 1992, survey methods were tested and distributional studies were conducted over the Bering Sea pack ice in spring and along the western Alaska coast during summer (Rugh et al. 1993). In 1993, the survey effort concentrated on known haul out sites in summer (Rugh et al. 1994). The sum of maximum counts of hauled out animals were 4,145 and 2,951 in 1992 and 1993, respectively. Using mean counts from days with the highest estimates for all sites visited in either 1992 or 1993, there were 3,570 seals seen, of which 3,356 (CV = 0.06) were hauled out (Rugh et al. 1995).



Studies to determine a correction factor for the number of spotted seals at sea missed during surveys have been initiated, but only preliminary results are currently available. The Alaska Department of Fish and Game placed satellite radio-transmitters on four spotted seals in Kasegaluk Lagoon and estimated the ratio of time hauled out versus time at sea. Preliminary results indicated that the proportion hauled out averaged about 6.8% (CV = 0.85) (Lowry et al. 1994). Using this correction factor with the maximum count of 4,145 from 1992 results in an estimate of 59,214.

### Minimum Population Estimate

A reliable minimum population estimate ( $N_{\text{MIN}}$ ) for this stock can not presently be determined because current reliable estimates of abundance are not available.

### Current Population Trend

Frost et al. (1993) report that counts of spotted seals have been relatively stable at Kasegaluk Lagoon since the late 1970s from the mid-1970s through 1991. As this represents only a fraction of the stock's range, reliable data on trends in population abundance for the Alaska stock of spotted seals are considered unavailable.

~~An element of concern is the potential for Arctic climate change, which will probably affect high northern latitudes more than elsewhere. There is evidence that over the last 10-15 years, there has been a shift in regional weather patterns in the Arctic region (Tynan and DeMaster 1996). Ice-associated seals, such as the spotted seal, are particularly sensitive to changes in weather and sea surface temperatures in that these strongly affect their ice habitats. There are insufficient data to make reliable predictions of the effects of Arctic climate change on the Alaska spotted seal stock.~~

### CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently unavailable for the Alaska stock of spotted seals. Hence, until additional data become available, it is recommended that the pinniped maximum theoretical net productivity rate ( $R_{\text{MAX}}$ ) of 12% be employed for this stock (Wade and Angliss 1997).

### POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 reauthorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor:  $PBR = N_{\text{MIN}} \times 0.5R_{\text{MAX}} \times F_R$ . The recovery factor ( $F_R$ ) for this stock is 0.5, the value for pinniped stocks with unknown population status (Wade and Angliss 1997). However, because a reliable estimate of  $N_{\text{MIN}}$  is currently not available, the PBR for this stock is unknown.

### ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

#### Fisheries Information

Three different commercial fisheries operating within the range of the Alaska stock of spotted seals were monitored for incidental take by NMFS observers during 1990-95/1989-2001: Bering Sea/Aleutian Islands groundfish trawl, longline, and pot fisheries. During this period, the estimated level of serious injury or mortality was 12 spotted seals, or approximately 1 spotted seal per year, all of which occurred in the groundfish trawl fishery (Perez 2003). As of 2003, changes to fishery definitions in the List of Fisheries has resulted in separating these three fisheries into 12 fisheries (69 FR 70094, 2 December 2004). ~~The only fishery for which incidental kill was reported was the Bering Sea/Aleutian Islands groundfish fishery, with 3 mortalities reported during 1996. Because no mortalities of spotted seals have been observed incidental to commercial fisheries from 1999-2003, the best estimate of the serious injury and mortality incidental to observed fisheries is zero. These mortalities resulted in an estimated 5 mortalities during that year, and an average of 1 (CV = 1.0) mortality per year over the 1995-99 period.~~

An additional source of information on the number of spotted seals killed or injured incidental to commercial fishing operations is the logbook reports maintained by vessel operators as required by the MMPA interim exemption program. During the 4-year period between 1990 and 1993, logbook reports from the Bristol Bay salmon drift gillnet and set gillnet fisheries (see Table 916) resulted in an annual mean of 1.5 mortalities from interactions with commercial fishing gear. However, because logbook records are most likely negatively biased (Credle et al. 1994), these are considered to be minimum estimates. These totals are based on all available logbook reports for Alaska fisheries through 1993. In 1990, logbook records from the Bristol Bay set and drift gillnet fisheries were combined. As a result, some of the spotted seal mortalities reported in 1990 may have occurred in the

set net fishery. Logbook data are available for part of 1989-1994, after which incidental mortality reporting requirements were modified. Under the new system, logbooks are no longer required; instead, fishers provide self-reports. Data for the 1994-95 phase-in period are fragmentary. After 1995, the level of reporting dropped dramatically, such that the records are considered incomplete and estimates of mortality based on them represent minimums (see Appendix 7 for details).

The estimated minimum mortality rate incidental to commercial fisheries is ~~2.5~~ **1.5** animals per year based on logbook and observer data. ~~Yet, it should be noted that most interactions with these fisheries are likely to be harbor seals rather than spotted seals, and that due to the difficulty of distinguishing between spotted and harbor seals, the reliability of these reports is questionable.~~ However, serious injury and mortality of harbor seals incidental to commercial fisheries has occurred within the past 5 years, and because it is virtually impossible to distinguish between these two species, some of the reported harbor seal take may actual involve spotted seals. Further, no observers have been assigned to the Bristol Bay drift gillnet fisheries that are known to interact with this stock **based on logbook data**, making the estimated mortality unreliable. Because the PBR for this stock is unknown, it is currently not possible to determine what annual mortality level is considered to be insignificant and approaching zero mortality and serious injury rate.

**Table 916.** Summary of incidental mortality of spotted seals (Alaska stock) due to commercial fisheries from 1990 through ~~1995~~ **2003** and calculation of the mean annual mortality rate. Mean annual mortality in brackets represents a minimum estimate from logbook reports.

Fishery name	Years	Data type	Range of observer coverage	Reported mortality (in given yrs.)	Estimated mortality (in given yrs.)	Mean annual mortality
<del>Bering Sea/Aleutian Is. (BSAI) groundfish trawl</del>	90-99	<del>obs data</del>	31-74%	<del>0, 0, 0, 0, 0, 0, 3, 0, 0, 0</del>	<del>0, 0, 0, 0, 0, 0, 5, 0, 0, 0</del>	<del>4 (CV=1.0)</del>
Bristol Bay salmon drift gillnet	90-93 <b>1990-2003</b>	logbook	n/a	5, 1, 0, 0 <b>1994 – 2003: n/a</b>	n/a	[1.5]
Minimum total annual mortality						<del>.25</del> <b>1.5 (CV=1.0)</b>

#### Subsistence/Native Harvest Information

Spotted seals are an important species for Alaskan subsistence hunters, primarily in the Bering Strait and Yukon-Kuskokwim regions, with estimated annual harvests ranging from 850 to 3,600 seals (averaging about 2,400 annually) taken during 1966-76 (Lowry 1984). From September 1985 to June 1986 the combined harvest from five Alaska villages was 986 (Quakenbush 1988). In a study designed to assess the subsistence harvest of harbor seals and Steller sea lions in Alaska, Wolfe and Mishler (1993, 1994, 1995, 1996) estimated subsistence takes of spotted seals in the northern part of Bristol Bay. The spotted seal take (including struck and lost) was estimated to be 437 in 1992, 265 in 1993, 270 in 1994, and 197 in 1995. Variance estimates for these values are not available. The mean annual subsistence take of spotted seals in this region during the 3-year period from 1993 to 1995 was 244 animals.

The Division of Subsistence, Alaska Department of Fish and Game, maintains a database that provides additional information on the subsistence harvest of ice seals in different regions of Alaska (ADF&G 2000a, b). Information on subsistence harvest of spotted seals has been compiled for 135 villages from reports from the Division of Subsistence (Coffing et al. 1998, Georgette et al. 1998, Wolfe and Hutchinson-Scarborough 1999) and a report from the Eskimo Walrus Commission (Sherrod 1982). Data were lacking for 22 villages; their harvests were estimated using the annual per capita rates of subsistence harvest from a nearby village. Harvest levels were estimated from data gathered in the 1980s for 16 villages; otherwise, data gathered from 1990-98 were used. As of August 2000, the subsistence harvest database indicated that the ~~the~~ estimated number of spotted seals harvested for subsistence use per year is 5,265.

**At this time, there are no efforts to quantify the current level of harvest of spotted seals by all Alaska communities. However, the U.S. Fish and Wildlife Service collects information on the level of spotted seal harvest in 5 villages during their Walrus Harvest Monitoring Program. Results from this program indicated that an average of 32 spotted seals were harvested annually in Little Diomed, Gambell, Savoonga, Shishmaref, and Wales from 1998-2003 (U.S. Fish and Wildlife Service, Marine Mammals Management, Walrus Harvest Monitoring Project). Because this represents only 5 of the over 100 villages that may harvest spotted seals, this level of harvest underestimates the actual harvest level for these years.**

A recent report on ice seal subsistence harvest in three Alaskan communities indicated that the number and species of ice seals harvested in a particular village may vary considerably between years (Coffing et al. 1999). These interannual differences are likely due to differences in ice and wind conditions that change the hunters' access to different ice habitats frequented by different types of seals. Regardless of the extent to which the harvest may vary interannually, it is clear that the harvest level of 5,265 spotted seals estimated by the Division of Subsistence is considerably higher than the previous minimum estimate of 244 per year based on reports from the northern Bristol Bay portion of the spotted seal's range. Although some of the more recent entries in the ADF&G database have associated measures of uncertainty (Coffing et al. 1999, Georgette et al. 1998), the overall total does not. The estimate of 5,265 spotted seals represents a mean estimate rather than a minimum estimate of subsistence harvest is the best estimate of harvest level currently available.

## STATUS OF STOCK

Spotted seals are not listed as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. Reliable estimates of the minimum population, PBR, and human-caused mortality and serious injury are currently not available. No information is available on the status of spotted seals. Due to a minimal level of interactions between U.S. commercial fisheries and spotted seals, the Alaska stock of spotted seals is not considered a strategic stock. However, due to a lack of information suggesting subsistence hunting is adversely affecting this stock and because of the minimal interactions between spotted seals and any U. S. fishery, the Alaska stock of spotted seals is not classified as a strategic stock. This classification is consistent with the recommendations of the Alaska Scientific Review Group (DeMaster 1995).

## Habitat Concerns

Evidence indicates that the Arctic climate is changing drastically and that one result of the change is a reduction in the extent of sea ice in at least in some regions of the Arctic (ACIA 2004, Johannessen et al. 2004). Spotted seals, along with other seals that are dependent on sea ice for at least part of their life history, will be vulnerable to reductions in sea ice. There are insufficient data to make reliable predictions of the effects of Arctic climate change on the Alaska spotted seal stock.

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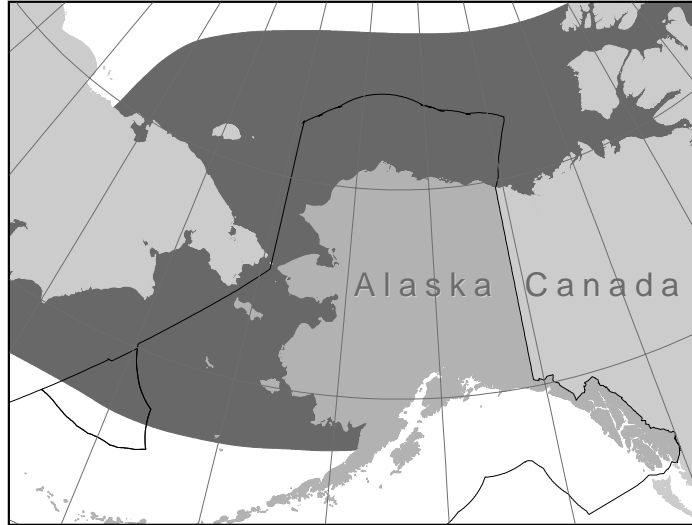
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## BEARDED SEAL (*Erignathus barbatus*): Alaska Stock

### STOCK DEFINITION AND GEOGRAPHIC RANGE

Bearded seals are circumpolar in their distribution, extending from the Arctic Ocean (85°N) south to Hokkaido (45°N) in the western Pacific. They generally inhabit areas of shallow water (less than 200 m) that are at least seasonally ice covered. During winter they are most common in broken pack ice (Burns 1967) and in some areas also inhabit shorefast ice (Smith and Hammill 1981). In Alaska waters, bearded seals are distributed over the continental shelf of the Bering, Chukchi, and Beaufort Seas (Ognev 1935, Johnson et al. 1966, Burns 1981, Fig. 4412). Bearded seals are evidently most concentrated from January to April over the northern part of the Bering Sea shelf (Burns 1981, Braham et al. 1984). Recent spring surveys along the Alaskan coast indicate that bearded seals tend to prefer areas of between 70% and 90% sea ice coverage, and are typically more abundant 20-100 nmi from shore than within 20 nmi of shore, with the exception of high



**Figure 4412.** Approximate distribution of bearded seals in Alaska waters (shaded area). The combined summer and winter distribution are depicted.

concentrations nearshore to the south of Kivalina (Bengtson et al. 2000; Bengtson et al. in review; Simpkins et al. 2003). Many of the seals that winter in the Bering Sea migrate north through the Bering Strait from late April through June, and spend the summer along the ice edge in the Chukchi Sea (Burns 1967, Burns 1981). The overall summer distribution is quite broad, with seals rarely hauled out on land, and some seals do not migrate but remain in open-water areas of the Bering and Chukchi Seas (Burns 1981, Nelson 1981, Smith and Hammill 1981). An unknown proportion of the population migrates southward from the Chukchi Sea in late fall and winter, and Burns (1967) noted a movement of bearded seals away from shore during that season as well.

The following information was considered in classifying stock structure based on the Dizon et al. (1992) phylogeographic approach: 1) Distributional data: geographic distribution continuous, 2) Population response data: unknown; 3) Phenotypic data: unknown; 4) Genotypic data: unknown. Based on this limited information, and the absence of any significant fishery interactions, there is currently no strong evidence to suggest splitting the distribution of bearded seals into more than one stock. Therefore, bearded seals range throughout the Arctic into Russian and Canadian waters, however, only the Alaska stock is recognized in U.S. waters.

### POPULATION SIZE

Early estimates of the Bering-Chukchi Sea population range from 250,000 to 300,000 (Popov 1976, Burns 1981). Surveys flown from Shismaref to Barrow during May-June 1999 and 2000 resulted in an average density of 0.07 seals/ km<sup>2</sup> and 0.14 seals/ km<sup>2</sup>, respectively, with consistently high densities along the coast to the south of Kivalina (Bengtson et al. in review). These densities cannot be used to develop an abundance estimate because no correction factor is available, and provided preliminary results indicating densities up to 0.149 bearded seals/km<sup>2</sup> and an estimated abundance of 4,862 in the eastern Chukchi Sea (NMML, unpublished data). However, preliminary results of surveys flown in 2000 indicate that the abundance may be much greater. Until this discrepancy is addressed and additional surveys are conducted, a reliable estimate of abundance for the Alaska stock of bearded seals is considered unavailable. There is no reliable population abundance estimate for the Alaska stock of bearded seals.



### Minimum Population Estimate

A reliable minimum population estimate ( $N_{\text{MIN}}$ ) for this stock can not presently be determined because current reliable estimates of abundance are not available.

### Current Population Trend

At present, reliable data on trends in population abundance for the Alaska stock of bearded seals are unavailable, though there is no evidence that population levels are declining.

~~An element of concern is the potential for Arctic climate change, which will probably affect high northern latitudes more than elsewhere. There is evidence that over the last 10–15 years, there has been a shift in regional weather patterns in the Arctic region (Tynan and DeMaster 1996). Ice associated seals, such as the bearded seal, are particularly sensitive to changes in weather and sea surface temperatures in that these strongly affect their ice habitats. There are insufficient data to make reliable predictions of the effects of Arctic climate change on the Alaska bearded seal stock.~~

### CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently unavailable for the Alaska stock of bearded seals. Hence, until additional data become available, it is recommended that the pinniped maximum theoretical net productivity rate ( $R_{\text{MAX}}$ ) of 12% be employed for this stock (Wade and Angliss 1997).

### POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 reauthorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor:  $PBR = N_{\text{MIN}} \times 0.5R_{\text{MAX}} \times F_R$ . The recovery factor ( $F_R$ ) for this stock is 0.5, the value for pinniped stocks with unknown population status (Wade and Angliss 1997). However, because a reliable estimate of minimum abundance  $N_{\text{MIN}}$  is currently not available, the PBR for this stock is unknown.

### ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

#### Fisheries Information

~~Three different commercial fisheries operating within the range of the Alaska stock of bearded seals were monitored for incidental take by NMFS observers during 1990–99: Bering Sea (and Aleutian Islands) groundfish trawl, longline, and pot fisheries. The only fishery for which incidental kill was observed was the Bering Sea groundfish trawl fishery, with 3 mortalities reported in 1991, 4 mortalities reported in 1994, 1 mortality reported in 1998, and 2 mortalities reported in 1999. These mortalities resulted in a mean annual (total) mortality rate of 0.6 (CV = 0.7) bearded seals per year. The range of observer coverage over the 5-year period from 1995–99, as well as the annual observed and estimated mortalities are presented in Table 10. It should be noted that one of the 1991 observed kills was later identified as a juvenile elephant seal (K. Wynne, pers. comm., University of Alaska). Further, only 1 mortality was reported during monitored hauls in 1994, which extrapolated to 2 mortalities for the entire fishery. Because NMFS observers recorded 3 additional bearded seal mortalities in unmonitored hauls, the estimated mortality in 1994 (2 seals) was known to be an underestimate. Accordingly, 4 was used as both the observed and estimated mortality for 1994 (Table 10). Similarly, while 2 mortalities were observed in 1999, the estimated mortality was calculated as 1; since this is clearly an underestimate, Table 10 incorporates the 2 observed mortalities as estimated mortalities for that year.~~

Until 2003, there were three different federally-regulated commercial fisheries in Alaska that could have interacted with bearded seals and were monitored for incidental mortality by fishery observers. As of 2003, changes in fishery definitions in the List of Fisheries has resulted in separating these three fisheries into 12 fisheries (69 FR 70094, 2 December 2004). This change does not represent a change in fishing effort, but provides managers with better information on the component of each fishery that is responsible for the incidental serious injury or mortality of marine mammal stocks in Alaska. Between 1999–2003, there were incidental serious injuries and mortalities of bearded seals in the following fisheries: Bering Sea/Aleutian Islands flatfish trawl and Bering Sea/Aleutian Islands pollock trawl (Table 17).

**Table 1017.** Summary of incidental mortality of bearded seals (Alaska stock) due to commercial fisheries from 1990 through 1999 1999-2003 and calculation of the mean annual mortality rate. Data from 1995 to 1999 are used in the mortality calculation when more than 5 years of data are provided for a particular fishery.

Fishery name	Years	Data type	Range of observer coverage	Observed mortality (in given yrs.)	Estimated mortality (in given yrs.)	Mean annual mortality
<del>Bering Sea/Aleutian Is. (BSAI) groundfish trawl</del>	90-99	obs data	31-74%	0, 3, 0, 0, 4, 0, 0, 0, 1, 2	0, 6, 0, 0, 4, 0, 0, 0, 1, 2	0.6 (CV = 0.67)
Bering Sea/Aleutian Is. flatfish trawl	1999 2000 2001 2002 2003	Obs data	66.3 64.5 57.6 N/A N/A	1 1 1 0 0	2 2 2 0 0	1.01 (0.37)
Bering Sea/Aleutian Is. pollock trawl	1999 2000 2001 2002 2003	Obs data	75.2 N/A N/A N/A N/A	0 0 0 0 0	1 0 0 0 0	0.20 (N/A)
Observer program total						0.6 1.2
Total estimated annual mortality						0.6 1.2

An additional source of information on the number of bearded seals killed or injured incidental to commercial fishing operations is the logbook reports maintained by vessel operators as required by the MMPA interim exemption program. During the 4-year period between 1990 and 1993, the only logbook reports for bearded seals detailed 14 mortalities and 31 injuries in the Bristol Bay salmon drift gillnet fishery in 1991. These reports are suspect because it is highly unlikely that bearded seals would have been in the Bristol Bay vicinity during the summer salmon fishing months. These logbook mortalities have not been included in Table 1016. However, because logbook records are most likely negatively biased (Credle et al. 1994), the absence of mortality reports does not assure bearded seal mortality did not occur. These logbook totals (zero animals) are based on all available logbook reports for Alaska fisheries through 1993. Logbook data are available for part of 1989-94, after which incidental mortality reporting requirements were modified. Under the new system, logbooks are no longer required; instead, fishers provide self-reports. Data for the 1994-95 phase-in period are fragmentary. After 1995, the level of reporting dropped dramatically, such that the records are considered incomplete and estimates of mortality based on them represent minimums (see Appendix 7 for details).

The estimated minimum mortality rate incidental to commercial fisheries is 0.61.2 bearded seals per year, based exclusively on observer data. Because the PBR for this stock is unknown, it is currently not possible to determine what annual mortality level is insignificant and approaching zero mortality and serious injury rate.

### Subsistence/Native Harvest Information

Bearded seals are an important species for Alaska subsistence hunters, with estimated annual harvests of 1,784 (SD = 941) from 1966 to 1977 (Burns 1981). Between August 1985 and June 1986, 791 bearded seals were harvested in five villages in the Bering Strait region based on reports from the Alaska Eskimo Walrus Commission (Kelly 1988).

The Division of Subsistence, Alaska Department of Fish and Game maintains a database that provides additional information on the subsistence harvest of ice seals in different regions of Alaska (ADF&G 2000a, b). Information on subsistence harvest of bearded seals has been compiled for 129 villages from reports from the Division of Subsistence (Coffing et al.; 1998; Georgette et al.; 1998; Wolfe and Hutchinson-Scarborough 1999) and a report from the Eskimo Walrus Commission (Sherrod 1982). Data were lacking for 22 villages; their harvests were estimated using the annual per capita rates of subsistence harvest from a nearby village. Harvest levels were estimated from data gathered in the 1980s for 16 villages; otherwise, data gathered from 1990-1998 were used. As of August 2000; the subsistence harvest database indicated that the the estimated number of bearded seals harvested for subsistence use per year is 6,788.

At this time, there are no efforts to quantify the current level of harvest of bearded seals by all Alaska communities. However, the U.S. Fish and Wildlife Service collects information on the level of bearded seal harvest in 5 villages during their Walrus Harvest Monitoring Program. Results from this program indicated that an average of 273 bearded seals were harvested annually in Little Diomed, Gambell, Savoonga, Shishmaref, and Wales from 1998-2003 (U.S. Fish and Wildlife Service, Marine Mammals Management, Walrus Harvest Monitoring Project). Because this represents only 5 of the over 100 villages that may harvest bearded seals, this level of harvest is known to underestimate the actual harvest level for these years.

A recent report on ice seal subsistence harvest in three Alaskan communities indicated that the number and species of ice seals harvested in a particular village may vary considerably between years (Coffing et al. 1999). These interannual differences are likely due to differences in ice and wind conditions that change the hunters' access to different ice habitats frequented by different types of seals. Regardless of the extent to which the harvest may vary interannually, it is clear that the harvest level of 6,788 bearded seals estimated by the ADF&G Division of Subsistence is considerably higher than the previous minimum estimate of 791 per year from 5 villages in the Bering Strait. Although some of the more recent entries in the ADF&G database have associated measures of uncertainty (Coffing et al. 1999, Georgette et al. 1998), the overall total does not. The estimate of 6,788 bearded seals represents a mean estimate rather than a minimum estimate of subsistence harvest is the best estimate of harvest level currently available.

## STATUS OF STOCK

Bearded seals are not listed as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. Reliable estimates of the minimum population, PBR, and human-caused mortality and serious injury are currently not available. No information is available on the status of bearded seals. Due to a very low level of interactions between U.S. commercial fisheries and bearded seals, the Alaska stock of bearded seals is not considered a strategic stock. Due to a lack of information suggesting subsistence hunting is adversely affecting this stock and because of the minimal interactions between bearded seals and any U. S. fishery, the Alaska stock of bearded seals is not classified as a strategic stock. This classification is consistent with the recommendations of the Alaska Scientific Review Group (DeMaster 1995: p. 26).

## Habitat Concerns

Evidence indicates that the Arctic climate is changing drastically and that one result of the change is a reduction in the extent of sea ice in at least in some regions of the Arctic (ACIA 2004, Johannessen et al. 2004). Bearded seals, along with other seals that are dependent on sea ice for at least part of their life history, will be vulnerable to reductions in sea ice. There are insufficient data to make reliable predictions of the effects of Arctic climate change on the Alaska bearded seal stock.

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## RINGED SEAL (*Phoca hispida*): Alaska Stock

### STOCK DEFINITION AND GEOGRAPHIC RANGE

Ringed seals have a circumpolar distribution from approximately 35°N to the North Pole, occurring in all seas of the Arctic Ocean (King 1983). In the North Pacific, they are found in the southern Bering Sea and range as far south as the Seas of Okhotsk and Japan. Throughout their range, ringed seals have an affinity for ice-covered waters and are well adapted to occupying seasonal and permanent ice. They tend to prefer large floes (i.e., > 48 m in diameter) and are often found in the interior ice pack where the sea ice coverage is greater than 90% (Simpkins et al. 2003). They remain in contact with ice most of the year and pup on the ice in late winter-early spring. Ringed seals are found throughout the Beaufort, Chukchi, and Bering Seas, as far south as Bristol Bay in years of extensive ice coverage (Fig. 4213). During late April through June, ringed seals are distributed throughout their range from the southern ice edge northward (Burns and Harbo 1972, Burns et al. 1981, Braham et al. 1984). Preliminary results from recent surveys conducted in the Chukchi Sea in May-June 1999 and 2000 indicate that ringed seal density is higher in nearshore fast and pack ice, and lower in offshore pack ice (Bengtson et al. in review), within 20 nmi from shore than 20-100 nmi from shore (Bengtson et al. 2000; NMML unpublished data). Results of surveys conducted in May and reported by Frost and Lowry (1999) indicate that, in the Alaskan Beaufort Sea, the density of ringed seals in May-June is higher to the east than to the west of Flaxman Island. The overall winter distribution is probably similar, and it is believed there is a net movement of seals northward with the ice edge in late spring and summer (Burns 1970). Thus, ringed seals occupying the Bering and southern Chukchi Seas in winter apparently are migratory, but details of their movements are unknown.



**Figure 813.** Approximate distribution of ringed seals in Alaska waters (shaded area). The combined summer and winter distribution are depicted.

The following information was considered in classifying stock structure based on the Dizon et al. (1992) phylogeographic approach: 1) Distributional data: geographic distribution continuous, 2) Population response data: unknown; 3) Phenotypic data: unknown; 4) Genotypic data: unknown. Based on this limited information, and the absence of any significant fishery interactions, there is currently no strong evidence to suggest splitting the distribution of ringed seals into more than one stock. Therefore, only the Alaska ringed seal stock is recognized in U.S. waters.

### POPULATION SIZE

A reliable abundance estimate for the entire Alaska stock of ringed seals is currently not available. Crude estimates of the abundance of ringed seals in Alaska include 1-1.5 million (Frost 1985) or 3.3-3.6 million (Frost et al. 1988). One partial estimate of ringed seal numbers is was based on aerial surveys conducted in May-June 1985, 1986, and 1987 by Frost et al. (1988). in the Chukchi and Beaufort Seas from southern Kotzebue Sound north and east to the U.S.-Canada border (Frost et al. 1988). Survey effort was directed towards shorefast ice within 20 nmi of shore, though some areas of adjacent pack ice were also surveyed, in the Chukchi and Beaufort Seas from southern Kotzebue Sound north and east to the U. S. - Canada border. The abundance estimate from of the number of hauled out seals in 1987 was 44,360 ± 9,130 (95% CI). More recently, During May-June 1999 and 2000 surveys were flown along lines perpendicular to the Alaskan eastern Chukchi Sea coast from Shishmaref to Barrow (Bengtson et al. in review) during May-June 1999 and 2000 (Bengtson et al. 2000; NMML unpublished data). Preliminary results from the 1999 survey indicate that the density of ringed seals in this area ranged from 0.39-3.67



km<sup>2</sup>; the total abundance in the area surveyed was estimated at 245,048 (Bengtson et al. 2000). Bengtson et al. (in review) indicate that the estimated abundance of ringed seals for the study area (corrected for seals not hauled out) in 1999 and 2000 was 252,488 (SE = 47,204) and 208,857 (SE = 25,502), respectively. Although the analysis of data from 2000 is not yet complete, the abundance estimate is unlikely to be substantially different (L. Hiruki-Raring, pers. comm.). Densities of ringed seals. Similar surveys were flown in 1996-1999 in the Alaska Beaufort Sea from Barrow to Kaktovik. in 1998 averaged 0.93 seals/km<sup>2</sup>; sObserved seal densities in that region ranged from 0.81-1.17/km<sup>2</sup> (Frost et al. 2002, 2004). Moulton et al. (2002) surveyed some of the same area in the central Beaufort Sea during 1997-1999, and reported lower seal densities than Frost et al. (2002). were higher to the east of Flaxman Island than to the west of Flaxman Island (1.19 seals/km<sup>2</sup> and 0.81 seals/km<sup>2</sup>, respectively). No Frost et al. (2002) did not produce a population estimates have been calculated for from their 1990s Alaska Beaufort Sea surveys. However, the area they surveyed covered approximately 18,000 km<sup>2</sup> (Lowry, pers. comm.), and the average seal density for all years and ice types was 0.98/ km<sup>2</sup> (Frost et al. 2002), which indicates that there were approximately 18,000 seals hauled out in the surveyed portion of the Beaufort Sea. While Combining this with the preliminary average abundance estimate of 230,673 from Bengtson et al. (in review) for the eastern Chukchi Sea results in a total of approximately 249,000 seals. 245,048 represents only a portion. This is a minimum population estimate because it does not include much of the geographic range of the stock, as many ringed seals occur in the Beaufort Sea, in the pack ice, and along the coast of Russia, and the estimate for the Alaska Beaufort Sea has not been has not been corrected for the numbers of ringed seals not hauled out at the time of the surveys. Nonetheless, it provides an update to the estimate from 1987.

### Minimum Population Estimate

A reliable minimum population estimate  $N_{\text{MIN}}$  for this stock can not presently be determined because current reliable estimates of abundance are not available.

### Current Population Trend

At present, reliable data on trends in population abundance for the Alaska stock of ringed seals are unavailable.

Frost et al. (2002) reported that trend analysis based on an ANOVA comparison of observed seal densities in the central Beaufort Sea suggested a marginally significant but substantial decline of 31% from 1980-87 to 1996-99. A Poisson regression model indicated highly significant density declines of 72% on fast ice and 43% on pack ice over the 15-year period. However, the apparent decline between the 1980s and the 1990s may have been due to a difference in the timing of surveys rather than an actual decline in abundance.

An element of concern is the potential for Arctic climate change, which will probably affect high northern latitudes more than elsewhere. There is evidence that over the last 10-15 years, there has been a shift in regional weather patterns in the Arctic region (Tynan and DeMaster 1996). Ice associated seals, such as the ringed seal, are particularly sensitive to changes in weather and sea surface temperatures in that these strongly affect their ice habitats. There are insufficient data to make reliable predictions of the effects of Arctic climate change on the Alaska ringed seal stock.

### CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently unavailable for the Alaska stock of ringed seals. Hence, until additional data become available, it is recommended that the pinniped maximum theoretical net productivity rate ( $R_{\text{MAX}}$ ) of 12% be employed for this stock (Wade and Angliss 1997).

### POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 reauthorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor:  $PBR = N_{\text{MIN}} \times 0.5R_{\text{MAX}} \times F_R$ . The recovery factor ( $F_R$ ) for this stock is 0.5, the value for pinniped stocks with unknown population status (Wade and Angliss 1997). However, because a reliable estimate of minimum abundance ( $N_{\text{MIN}}$ ) is currently not available, the PBR for this stock is unknown.



## ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

### Fisheries Information

Three different commercial fisheries operating within the range of the Alaska stock of ringed seals were monitored for incidental take by NMFS observers during 1990-99: Bering Sea (and Aleutian Islands) groundfish trawl, longline, and pot fisheries. The only fishery for which incidental kill was observed was the Bering Sea groundfish trawl fishery, with 2 mortalities reported in 1992. Because no mortalities have been observed since 1992, the mean annual mortality rate is 0. The range of observer coverage over the 10 year period, as well as the annual observed and estimated mortalities are presented in Table 11.

Until 2003, there were three different federally-regulated commercial fisheries in Alaska that could have interacted with ringed seals and were monitored for incidental mortality by fishery observers. As of 2003, changes in fishery definitions in the List of Fisheries has resulted in separating these three fisheries into 12 fisheries (69 FR 70094, 2 December 2004). This change does not represent a change in fishing effort, but provides managers with better information on the component of each fishery that is responsible for the incidental serious injury or mortality of marine mammal stocks in Alaska. Between 1999-2003, there were incidental serious injuries and mortalities of ringed seals in the Bering Sea/Aleutian Islands pollock trawl fishery (Table 18).

An additional source of information on the number of ringed seals killed or injured incidental to commercial fishing operations is the logbook reports maintained by vessel operators as required by the MMPA interim exemption program. During the 4-year period between 1990 and 1993, logbook reports from all Alaska fisheries indicated no mortalities of ringed seals. Logbook data are available for part of 1989-1994, after which incidental mortality reporting requirements were modified. Under the new system, logbooks are no longer required; instead, fishers provide self-reports. Data for the 1994-95 phase-in period are fragmentary. After 1995, the level of reporting dropped dramatically, such that the records are considered incomplete and estimates of mortality based on them represent minimums (see Appendix 7 for details). There have been no logbook reports of ringed seal mortalities or injuries.

**Table 11-18.** Summary of incidental mortality of ringed seals (Alaska stock) due to commercial fisheries from 1990 through 1999 1999-2003 and calculation of the mean annual mortality rate. Data from 1995 to 1999 are used in the mortality calculation when more than 5 years of data are provided for a particular fishery.

Fishery name	Years	Data type	Range of observer coverage	Observed mortality (in given yrs.)	Estimated mortality (in given yrs.)	Mean annual mortality
<del>Bering Sea/Aleutian Is. (BSAI) groundfish trawl</del>	90-99	obs data	9.7-74%	0, 0, 2, 0, 0, 0, 0, 0, 0, 0	0, 0, 3, 0, 0, 0, 0, 0, 0, 0	0
Bering Sea/Aleutian Is. pollock trawl	1999 2000 2001 2002 2003	Obs data	75.2 76.2 79.0 80.0 82.2	0 1 2 0 0	0 1 2 0 0	0.71 (CV = 0.24)
Total estimated annual mortality						0 0.71 (CV = 0.24)

Based on data from 1995-1999 1999-2003, there have been an average of 0.71 no mortalities of ringed seals incidental to commercial fishing operations. Because the PBR for this stock is unknown, it is currently not possible to determine what annual mortality level considered to be insignificant and approaching zero mortality and serious injury rate.

### Subsistence/Native Harvest Information

Ringed seals are an important species for Alaska Native subsistence hunters. The estimated annual subsistence harvest in Alaska dropped from 7,000 to 15,000 in the period from 1962 to 1972 to an estimated 2,000-3,000 in 1979 (Frost unpubl. report). Based on data from two villages on St. Lawrence Island, the annual take in Alaska during the mid-1980s likely exceeded 3,000 seals (Kelly 1988).

The Division of Subsistence, Alaska Department of Fish and Game, maintains a database that provides additional information on the subsistence harvest of ice seals in different regions of Alaska (ADF&G 2000a, b).

Information on subsistence harvest of ringed seals has been compiled for 129 villages from reports from the Division of Subsistence (Coffing et al. 1998, Georgette et al. 1998, Wolfe and Hutchinson-Scarborough 1999) and a report from the Eskimo Walrus Commission (Sherrod 1982). Data were lacking for 22 villages; their harvests were estimated using the annual per capita rates of subsistence harvest from a nearby village. Harvest levels were estimated from data gathered in the 1980s for 16 villages; otherwise, data gathered from 1990-98 were used. As of August 2000, the subsistence harvest database indicated that the estimated number of ringed seals harvested for subsistence use per year is 9,567.

At this time, there are no efforts to quantify the level of harvest of ringed seals by all Alaska communities. However, the U.S. Fish and Wildlife Service collects information on the level of ringed seal harvest in 5 villages during their Walrus Harvest Monitoring Program. Results from this program indicated that an average of 47 ringed seals were harvested annually in Little Diomed, Gambell, Savoonga, Shishmaref, and Wales from 1998-2003 (U.S. Fish and Wildlife Service, Marine Mammals Management, Walrus Harvest Monitoring Project). Because this represents only 5 of the over 100 villages that may harvest ringed seals, this level of harvest is known to underestimate the actual harvest level for these years.

A recent report on ice seal subsistence harvest in three Alaskan communities indicated that the number and species of ice seals harvested in a particular village may vary considerably between years (Coffing et al. 1999). These interannual differences are likely due to differences in ice and wind conditions that change the hunters' access to different ice habitats frequented by different types of seals. Regardless of the extent to which the harvest may vary interannually, it is clear that the harvest level of 9,567 ringed seals estimated by the Division of Subsistence is considerably higher than the previous minimum estimate. Although some of the more recent entries in the ADF&G database have associated measures of uncertainty (Coffing et al. 1999, Georgette et al. 1998), the overall total does not. The estimate of 9,567 ringed seals is the best estimate currently available. ~~represents a mean estimate rather than a minimum estimate of subsistence harvest.~~

## STATUS OF STOCK

Ringed seals are not listed as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. Reliable estimates of the minimum population, PBR, and human-caused mortality and serious injury are currently not available. No information is available on the status of ringed seals. Due to a very low level of interactions between U.S. commercial fisheries and ringed seals, the Alaska stock of ringed seals is not considered a strategic stock. ~~Due to a lack of information suggesting subsistence hunting is adversely affecting this stock and because of the minimal interactions between ringed seals and any U. S. fishery, the Alaska stock of ringed seals is not classified as a strategic stock. This classification is consistent with the recommendations of the Alaska Scientific Review Group (DeMaster 1995).~~

## Habitat Concerns

Evidence indicates that the Arctic climate is changing drastically and that one result of the change is a reduction in the extent of sea ice in at least in some regions of the Arctic (ACIA 2004, Johannessen et al. 2004). Ringed seals, along with other seals that are dependent on sea ice for at least part of their life history, will be vulnerable to reductions in sea ice. There are insufficient data to make reliable predictions of the effects of Arctic climate change on the Alaska ringed seal stock.

Oil and gas exploration and development overlaps with both the summer and winter ranges of ringed seals in the Alaska Beaufort Sea. NMFS has worked with the oil and gas industry to recommend changes to operations to ensure that mortalities of ringed seals are eliminated or minimized, and to ensure that monitoring occurs to verify that population-level changes in distribution are minor. There has been concern that oil and gas exploration, especially seismic exploration, could result in changes in ringed seal distribution. However, aerial surveys conducted for three years both before and after industry activities indicate that local seal densities in the spring were not significantly different after the advent of industry activity (Moulton et al. 2004).

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## RIBBON SEAL (*Phoca fasciata*): Alaska Stock

### STOCK DEFINITION AND GEOGRAPHIC RANGE

Ribbon seals inhabit the North Pacific Ocean and adjacent fringes parts of the Arctic Ocean. In Alaska waters, ribbon seals are found in the open sea, on the pack ice, and only rarely on shorefast ice (Kelly 1988). They range northward from Bristol Bay in the Bering Sea into the Chukchi and western Beaufort Seas (Fig. 4314). From late March to early May, ribbon seals inhabit the Bering Sea ice front (Burns 1970, Burns 1981, Braham et al. 1984). They are most abundant in the northern part of the ice front in the central and western parts of the Bering Sea (Burns 1970, Burns et al. 1981). As the ice recedes in May to mid-July the seals move farther to the north in the Bering Sea, where they haul out on the receding ice edge and remnant ice (Burns 1970, Burns 1981, Burns et al. 1981). There has been little agreement on little known about the range of ribbon seals during the rest of the year. Recent sightings and a review of the literature suggest that many ribbon seals migrate into the Chukchi Sea for the summer (Kelly 1988).



**Figure 4314** Approximate distribution of ribbon seals in Alaska waters—(shaded area). The combined summer and winter distribution is depicted.

The following information was considered in classifying stock structure based on the Dizon et al. (1992) phylogeographic approach: 1) Distributional data: geographic distribution continuous, 2) Population response data: unknown; 3) Phenotypic data: unknown; 4) Genotypic data: unknown. Based on this limited information, and the absence of any significant fishery interactions, there is currently no strong evidence to suggest splitting the distribution of ribbon seals into more than one stock. Therefore, only the Alaska stock of ribbon seal is recognized in U.S. waters.

### POPULATION SIZE

A reliable abundance estimate for the Alaska stock of ribbon seals is currently not available. Burns (1981) estimated the worldwide population of ribbon seals at 240,000 in the mid-1970s, with an estimate for the Bering Sea at 90,000-100,000.

### Minimum Population Estimate

A reliable minimum population estimate ( $N_{\text{MIN}}$ ) for this stock can not presently be determined because current reliable estimates of abundance are not available.

### Current Population Trend

At present, reliable data on trends in population abundance for the Alaska stock of ribbon seals are unavailable.

An element of concern is the potential for Arctic climate change, which will probably affect high northern latitudes more than elsewhere. There is evidence that over the last 10-15 years, there has been a shift in regional weather patterns in the Arctic region (Tynan and DeMaster 1996). Ice associated seals, such as the ribbon seal, are particularly sensitive to changes in weather and sea surface temperatures in that these strongly affect their ice habitats. There are insufficient data to make reliable predictions of the effects of Arctic climate change on the Alaska ribbon seal stock.

## CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently unavailable for the Alaska stock of ribbon seals. Hence, until additional data become available, it is recommended that the pinniped maximum theoretical net productivity rate ( $R_{MAX}$ ) of 12% be employed for this stock (Wade and Angliss 1997).

## POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 reauthorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor:  $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$ . The recovery factor ( $F_R$ ) for this stock is 0.5, the value for pinniped stocks with unknown population status (Wade and Angliss 1997). However, because a reliable estimate of minimum abundance  $N_{MIN}$  is currently not available, the PBR for this stock is unknown.

## ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

### Fisheries Information

Three different commercial fisheries operating within the range of the Alaska stock of ribbon seals were monitored for incidental take by NMFS observers during 1990-99: Bering Sea (and Aleutian Islands) groundfish trawl, longline, and pot fisheries. The only fishery for which incidental kill was observed was the Bering Sea groundfish trawl fishery, with 1 mortality reported in 1990, 1991, and 1997. Averaging the estimated mortalities over the 1995-99 period results in a mean annual (total) mortality rate of 0.2 ( $CV = 1.0$ ) ribbon seals per year. The range of observer coverage over the 10-year period, as well as the annual observed and estimated mortalities are presented in Table 12.

Until 2003, there were three different federally-regulated commercial fisheries in Alaska that could have interacted with ribbon seals and were monitored for incidental mortality by fishery observers. As of 2003, changes in fishery definitions in the List of Fisheries has resulted in separating these three fisheries into 13 fisheries (69 FR 70094, 2 December 2004). This change does not represent a change in fishing effort, but provides managers with better information on the component of each fishery that is responsible for the incidental serious injury or mortality of marine mammal stocks in Alaska. Between 1999-2003, there were incidental serious injuries and mortalities of ribbon seals in the Bering Sea/Aleutian Islands pollock trawl fishery and the Bering Sea/Aleutian Islands Pacific cod longline fishery (Table 19).

An additional source of information on the number of ribbon seals killed or injured incidental to commercial fishing operations is the logbook reports maintained by vessel operators as required by the MMPA interim exemption program. During the 4-year period between 1990 and 1993, logbook reports from all Alaska fisheries indicated no mortalities of ribbon seals. Logbook data are available for part of 1989-94, after which incidental mortality reporting requirements were modified. Under the new system, logbooks are no longer required; instead, fishers provide self-reports. Data for the 1994-95 phase-in period are fragmentary. After 1995, the level of reporting dropped dramatically, such that the records are considered incomplete and estimates of mortality based on them represent minimums (see Appendix 7 for details). There have been no logbook reports of ribbon seal mortalities or injuries.

**Table 12.** Summary of incidental mortality of ribbon seals (Alaska stock) due to commercial fisheries from 1990 through 1995 and calculation of the mean annual mortality rate. Data from 1991 to 1995 are used in the mortality calculation when more than 5 years of data are provided for a particular fishery.

Fishery name	Years	Data type	Range of observer coverage	Observed mortality (in given yrs.)	Estimated mortality (in given yrs.)	Mean annual mortality
Bering Sea/Aleutian Is. (BSAI) groundfish trawl	90-99	obs data	53-74%	1, 1, 0, 0, 0, 0, 0, 1, 0, 0	1, 1, 0, 0, 0, 0, 0, 2, 0, 0	0.2 ( $CV = 1.0$ )
Bering Sea/Aleutian Is. pollock trawl	1999 2000 2001 2002 2003	obs data	75.2 76.2 79.0 80.0 82.2	0 0 1 0 0	0 0 1 0 0	0.20 (n/a)



Fishery name	Years	Data type	Range of observer coverage	Observed mortality (in given yrs.)	Estimated mortality (in given yrs.)	Mean annual mortality
Bering Sea/Aleutian Is. Pacific cod longline	1999 2000 2001 2002 2003	obs data	31.8 35.2 29.5 29.6 29.8	0 0 1 0 0	0 0 3 0 0	0.60 (0.82)
Total estimated annual mortality						0.2-0.8

The estimated minimum mortality rate incidental to commercial fisheries is ~~40.8~~ ribbon seal per year (~~rounded up from 0.2~~), based exclusively on observer data. Because the PBR for this stock is unknown, it is currently not possible to determine what annual mortality level is considered to be insignificant and approaching zero mortality and serious injury rate. ~~However, if there were 50,000 ribbon seals the PBR would equal 1,500 ( $50,000 \times 0.06 \times 0.5 = 1,500$ ), and annual mortality levels less than 150 animals (i.e., 10% of PBR) would be considered insignificant. Currently, there is no reason to believe there are less than 50,000 ribbon seals in U. S. waters.~~

### Subsistence/Native Harvest Information

Ribbon seals are ~~an important species~~ harvested occasionally by for Alaska Native subsistence hunters, primarily from villages in the vicinity of the Bering Strait and to a lesser extent at villages along the Chukchi Sea coast (Kelly 1988). The annual subsistence harvest was estimated to be less than 100 seals annually from 1968 to 1980 (Burns 1981). In the mid-1980s, the Alaska Eskimo Walrus Commission estimated the subsistence take to still be less than 100 seals annually (Kelly 1988).

The Division of Subsistence, Alaska Department of Fish and Game maintains a database that provides additional information on the subsistence harvest of ice seals in different regions of Alaska (ADF&G 2000a, b). Information on subsistence harvest of ribbon seals has been compiled for 129 villages from reports from the Division of Subsistence (Coffing et al. 1998, Georgette et al. 1998, Wolfe and Hutchinson-Scarborough 1999) and a report from the Eskimo Walrus Commission (Sherrod 1982). Data were lacking for 22 villages; their harvests were estimated using the annual per capita rates of subsistence harvest from a nearby village. Harvest levels were estimated from data gathered in the 1980s for 16 villages; otherwise, data gathered from 1990-98 were used. As of August 2000, the subsistence harvest database indicated that the ~~the~~ estimated number of ribbon seals harvested for subsistence use per year is 193.

At this time, there are no efforts to quantify the level of harvest of ribbon seals by all Alaska communities. However, the U.S. Fish and Wildlife Service collects information on the level of ribbon seal harvest in 5 villages as part of their Walrus Harvest Monitoring Program. Results from this program indicated that an average of 13 ribbon seals were harvested annually in Little Diomed, Gambell, Savoonga, Shishmaref, and Wales from 1999-2003 (U.S. Fish and Wildlife Service, Marine Mammals Management, Walrus Harvest Monitoring Project). Because this represents only 5 of the over 100 villages that may harvest ribbon seals, this level of harvest is known to underestimate the actual harvest level for these years.

A recent report on ice seal subsistence harvest in three Alaskan communities indicated that the number and species of ice seals harvested in a particular village may vary considerably between years (Coffing et al. 1999). These interannual differences are likely due to differences in ice and wind conditions that change the hunters' access to different ice habitats frequented by different types of seals. Regardless of the extent to which the harvest may vary interannually, it is clear that the harvest level of 193 ribbon seals estimated by the Division of Subsistence is considerably ~~somewhat~~ higher than the previous minimum estimate. Although some of the more recent entries in the ADF&G database have associated measures of uncertainty (Coffing et al. 1999, Georgette et al. 1998), the overall total does not. The estimate of 193 ribbon seals represents a mean estimate rather than a minimum estimate of subsistence harvest.

### STATUS OF STOCK

Ribbon seals are not listed as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. Reliable estimates of the minimum population, PBR, and human-caused mortality and serious injury are currently not available. No information is available on the status of ribbon seals. Due to a very

low level of interactions between U.S. commercial fisheries and ribbon seals, the Alaska stock of ribbon seals is not considered a strategic stock. Due to a lack of information suggesting subsistence hunting is adversely affecting this stock and because of the minimal interactions between ribbon seals and any U. S. fishery, the Alaska stock of ribbon seals is not classified as a strategic stock. This classification is consistent with the recommendations of the Alaska Scientific Review Group (DeMaster 1995).

### Habitat Concerns

Evidence indicates that the Arctic climate is changing drastically and that one result of the change is a reduction in the extent of sea ice in at least in some regions of the Arctic (ACIA 2004, Johannessen et al. 2004). Ribbon seals, along with other seals that are dependent on sea ice for at least part of their life history, will be vulnerable to reductions in sea ice. There are insufficient data to make reliable predictions of the effects of Arctic climate change on the Alaska ribbon seal stock.

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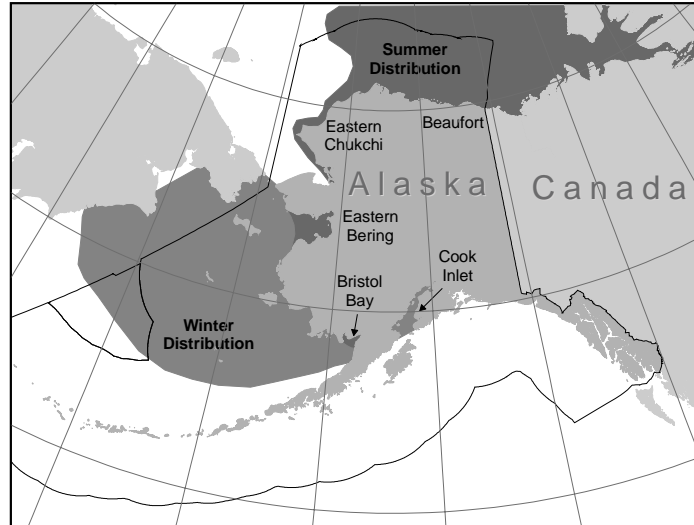
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## BELUGA WHALE (*Delphinapterus leucas*): Beaufort Sea Stock

### STOCK DEFINITION AND GEOGRAPHIC RANGE

Beluga whales are distributed throughout seasonally ice-covered arctic and subarctic waters of the Northern Hemisphere (Gurevich 1980), and are closely associated with open leads and polynyas in ice-covered regions (Hazard 1988). Depending on season and region, beluga whales may occur in both offshore and coastal waters, with concentrations in Cook Inlet, Bristol Bay, Norton Sound, Kasegaluk Lagoon, and the Mackenzie Delta (Hazard 1988). It is assumed that most beluga whales from these summering areas overwinter in the Bering Sea, excluding those found in the northern Gulf of Alaska (Shelden 1994). Seasonal distribution is affected by ice cover, tidal conditions, access to prey, temperature, and human interaction (Lowry 1985). During the winter, beluga whales occur in offshore waters associated with pack ice. In the spring, they migrate to warmer coastal estuaries, bays, and rivers for molting (Finley 1982) and calving (Sergeant and Brodie 1969). Annual migrations may cover thousands of kilometers (Reeves 1990).



**Figure 4415** Approximate distribution of beluga whales in Alaska waters. The dark shading displays the summer distribution of the five stocks. Winter distributions are depicted with lighter shading.

The following information was considered in classifying beluga whale stock structure based on the Dizon et al. (1992) phylogeographic approach: 1) Distributional data: geographic distribution discontinuous in summer (Frost and Lowry 1990), distribution unknown outside of summer; 2) Population response data: possible extirpation of local populations; distinct population trends between regions occupied in summer; 3) Phenotypic data: unknown; and 4) Genotypic data: mitochondrial DNA analyses indicate distinct differences among summering areas (O'Corry-Crowe et al. 1997). Based on this information, 5 stocks of beluga whales are recognized within U. S. waters: 1) Cook Inlet, 2) Bristol Bay, 3) eastern Bering Sea, 4) eastern Chukchi Sea, and 5) Beaufort Sea (Fig. 4415).

### POPULATION SIZE

The sources of information to estimate abundance for belugas in the waters of northern Alaska and western Canada have included both opportunistic and systematic observations. Duval (1993) reported an estimate of 21,000 for the Beaufort Sea stock, similar to that reported by Seaman et al. (1985). The most recent aerial survey was conducted in July of 1992, when stock size was estimated to include and resulted in an estimate of 19,629 (CV = 0.229) beluga whales in the eastern Beaufort Sea (Harwood et al. 1996). To account for availability bias a correction factor (CF), which was not data-based, has been recommended for the Beaufort Sea beluga whale stock (Duval 1993), resulting in a population estimate of 39,258 (19,629 × 2) animals. A CV for the CF is not available; however, this CF was considered negatively biased by the Alaska SRG considering that aerial survey CFs for this species typically range have been estimated to be between 2.5 and 3.27 (Frost and Lowry 1995).

### Minimum Population Estimate

For the Beaufort Sea stock of beluga whales, the minimum population estimate ( $N_{\text{MIN}}$ ) is calculated according to Equation 1 from the PBR Guidelines (Wade and Angliss 1997). Thus,  $N_{\text{MIN}} = N / \exp(0.842 \times [\ln(1 + [CV(N)]^2)]^{1/2})$ . Using the population estimate (N) of 39,258 and an associated CV(N) of 0.229,  $N_{\text{MIN}}$  for this stock is 32,453.

### Current Population Trend

The Beaufort Sea stock of beluga whales is considered to be stable or increasing (DeMaster 1995). The current population trend of the Beaufort Sea stock of beluga whales is unknown.

### CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently unavailable for the Beaufort Sea stock of beluga whales. Hence, until additional data become available, it is recommended that the cetacean maximum theoretical net productivity rate ( $R_{MAX}$ ) of 4% be employed for this stock (Wade and Angliss 1997).

### POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 reauthorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor:  $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$ . As the stock trend is unknown, is considered to be stable or increasing, (DeMaster 1995), the recovery factor ( $F_R$ ) for this stock is 1-00.5 (Wade and Angliss 1997). Thus, for the Beaufort Sea stock of beluga whales,  $PBR = 649324$  animals ( $32,453 \times 0.02 \times 10.5$ ).

### ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

#### Fisheries Information

The total fishery mortality and serious injury for this stock is estimated to be zero as there are no reports of mortality incidental to commercial fisheries in recent years.

#### Subsistence/Native Harvest Information

The subsistence take of beluga whales from this stock within U. S. waters is reported by the Alaska Beluga Whale Committee (ABWC). The most recent Alaska Native subsistence harvest estimates for the Beaufort Sea beluga stock are provided in Table 13a20 (Frost and Suydam 1995, Frost 1998, Frost 2003, Frost pers. comm. 2004). Given these data, the annual subsistence take by Alaska Natives averaged 6853 belugas during the 5-year period from 1996-2000/1999-2003. Recent harvest reports are not considered negatively biased because even though they are based on on-site harvest monitoring and harvest reports from well established ABWC representatives. The 1993-95 data are negatively biased because reliable estimates for the number of animals struck and lost are not available prior to 1996.

**Table 13a20.** Summary of the Alaska Native subsistence harvest from the Beaufort Sea stock of beluga whales, 1993-1999-20003. Canadian subsistence takes are provided in Table 13b20. n/a indicates the data are not available.

Year	Reported total number taken	Estimated range of total take	Reported number harvested	Estimated number struck and lost
1993	85 <sup>+2</sup>	n/a	85 <sup>2</sup>	n/a
1994	63 <sup>2</sup>	n/a	62	1 <sup>2</sup>
1995	44 <sup>+</sup>	n/a	44	n/a
1996	42	n/a	24	18
1997	71	69-73	43	26-30
1998	65	n/a	59	6
1999	45+	n/a	35	10+
2000	117	n/a	66	51
2001	43	n/a	25	18
2002	27	n/a	24	3
2003	34	n/a	34	unknown
Mean annual take (1996-2000/1999-2003)	6853			

<sup>+</sup> Does not include the number of struck and lost; <sup>2</sup> Indicates a lower bound.

The subsistence take of beluga whales within Canadian waters of the Beaufort Sea is reported by the Fisheries Joint Management Committee (FJMC). The data are collected by on-site harvest monitoring conducted by the FJMC at Inuvialuit communities in the Mackenzie River delta, Northwest Territories. The most recent Canadian

Inuvialuit subsistence harvest estimates for the Beaufort Sea beluga stock are provided in Table 43b21 (Harwood et al, in press; data for 2000 from FJMC Beluga Monitor Program, Fisheries Joint Management Committee, Inuvik, NT, Canada). Given these data, the annual subsistence take in Canada averaged 109 belugas during the 5-year period from 1996-00. If we assume that the average Canadian subsistence harvest in 1999-2003 is the same as the average from 1996-2000, Therefore, the mean estimated subsistence take in Canadian and U. S. waters from the Beaufort Sea beluga stock during 1999-2003 is 477162 (53 + 109) whales.

**Table 43b21.** Summary of the Canadian subsistence harvest from the Beaufort Sea stock of beluga whales, 1993-2000. Subsistence harvest reports for 2001-2003 were not available at the time of publication. n/a indicates the data are not available.

Year	Reported total number taken	Estimated range of total take	Reported number harvested	Reported number struck and lost
1993	120	n/a	110	10
1994	149	n/a	141	8
1995	143	n/a	129	14
1996	139	n/a	120	19
1997	123	n/a	114	9
1998	93	n/a	86	7
1999	102	n/a	86	16
2000	89	n/a	82	7
Mean annual take (1996-00)	109			

## STATUS OF STOCK

Beaufort Sea beluga whales are not listed as “depleted” under the MMPA or listed as “threatened” or “endangered” under the Endangered Species Act. Based on a lack of reported mortalities, the estimated annual fishery-related mortality (0) is not known to exceed 10% of the PBR (6532) and, therefore, is considered to be insignificant and approaching zero mortality and serious injury rate. Based on currently available data, the estimated annual level of human-caused mortality and serious injury (477162) is not known to exceed the PBR (649324). Therefore, the Beaufort Sea stock of beluga whales is not classified as a strategic stock. The population size is considered stable or increasing, however, At this time it is not possible to assess the status of this stock relative to its Optimum Sustainable Population size.

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## BELUGA WHALE (*Delphinapterus leucas*): Eastern Chukchi Sea Stock

### STOCK DEFINITION AND GEOGRAPHIC RANGE

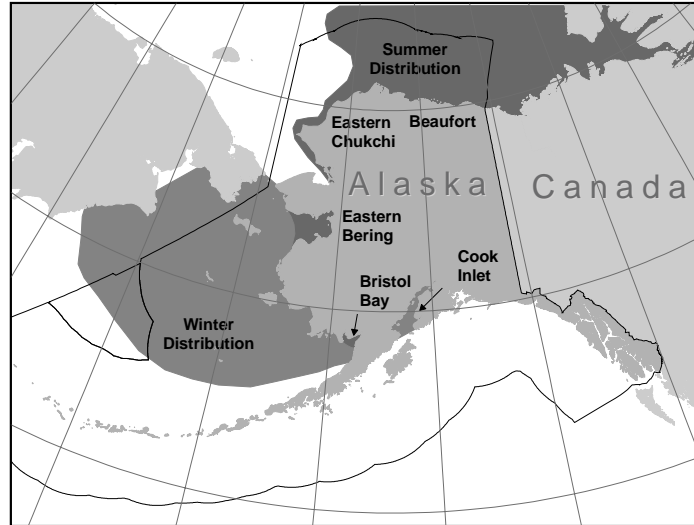
Beluga whales are distributed throughout seasonally ice-covered arctic and subarctic waters of the Northern Hemisphere (Gurevich 1980), and are closely associated with open leads and polynyas in ice-covered regions (Hazard 1988). Depending on season and region, beluga whales may occur in both offshore and coastal waters, with concentrations in Cook Inlet, Bristol Bay, Norton Sound, Kasegaluk Lagoon, and the Mackenzie Delta (Hazard 1988). It is assumed that most beluga whales from these summering areas overwinter in the Bering Sea, excluding those found in the northern Gulf of Alaska (Shelden 1994). Seasonal distribution is affected by ice cover, tidal conditions, access to prey, temperature, and human interaction (Lowry 1985). Satellite tagging efforts directed at the eastern Chukchi stock of beluga whales showed that whales tagged in the eastern Chukchi in summer traveled 1,100 km north of the Alaska coastline and to the Canadian Beaufort Sea within 3 months of tagging (Suydam et al. 2001), indicating significant stock overlap with the Beaufort Sea stock of beluga whales. During the winter, beluga whales occur in offshore waters associated with pack ice. In the spring, they migrate to warmer coastal estuaries, bays, and rivers for molting (Finley 1982) and calving (Sergeant and Brodie 1969). Annual migrations may cover thousands of kilometers (Reeves 1990).

The following information was considered in classifying beluga whale stock structure based on the Dizon et al. (1992) phylogeographic approach: 1) Distributional data: geographic distribution discontinuous in summer (Frost and Lowry 1990), distribution unknown outside of summer; 2) Population response data: possible extirpation of local populations; distinct population trends between regions occupied in summer; 3) Phenotypic data: unknown; and 4) Genotypic data: mitochondrial DNA analyses indicate distinct differences among summering areas (O'Corry-Crowe et al. 1997). Based on this information, 5 stocks of beluga whales are recognized within U. S. waters: 1) Cook Inlet, 2) Bristol Bay, 3) eastern Bering Sea, 4) eastern Chukchi Sea, and 5) Beaufort Sea (Fig. 16).

### POPULATION SIZE

Frost et al. (1993) estimated the minimum size of the eastern Chukchi stock of belugas at 1,200, based on counts of animals from aerial surveys conducted during 1989-91. Survey effort was concentrated on the 170 km long Kasegaluk Lagoon, an area known to be regularly used by belugas during the open-water season. Other areas that belugas from this stock are known to frequent (e.g., Kotzebue Sound) were not surveyed. Therefore, the survey effort resulted in a minimum count. If this count is corrected, using radio telemetry data, for the proportion of animals that were diving and thus not visible at the surface (2.62, Frost and Lowry 1995), and for the proportion of newborns and yearlings not observed due to small size and dark coloration (1.18; Brodie 1971), the total corrected abundance estimate for the eastern Chukchi stock is 3,710 ( $1,200 \times 2.62 \times 1.18$ ).

During 25 June to 6 July 1998, aerial surveys were conducted in the eastern Chukchi Sea (DeMaster et al. 1998). The maximum single day count (1,172 whales) was derived from a photographic count of a large aggregation near Icy Cape (1,018), plus animals (154) counted along an ice edge transect. This count is an underestimate because it was clear to the observers that many more whales were present along and in the ice than they were able to count and only a small portion of the ice edge habitat was surveyed. Furthermore, only one of



**Figure 16.** Approximate distribution of beluga whales in Alaska waters. The dark shading displays the summer distribution of the five stocks. Winter distributions are depicted with lighter shading.

five belugas equipped with satellite tags a few days earlier remained within the survey area on the day the peak count occurred (DeMaster et al. 1998).

In July 2002, aerial surveys were conducted again in the eastern Chukchi Sea (Lowry and Frost 2002). Those surveys resulted in a peak count of 582 whales. A correction factor for animals that were not available for the count is not available. Offshore sightings during this survey combined with satellite tag data collected in 2001 (Lowry and Frost 2001, Lowry and Frost 2002) indicate that nearshore surveys for beluga will only result in partial counts of this stock.

It is not possible to estimate the abundance for this stock from the 1998 survey. Not only were a large number of whales unavailable for counting, but the large Icy Cape aggregation was in shallow, clear water (DeMaster et al. 1998). Currently, a correction factor (to account for missed whales) does not exist for belugas encountered in such conditions. As a result, the abundance estimate from the 1989-91 surveys (3,710 whales) is still considered to be the most reliable for the eastern Chukchi Sea beluga whale stock.

### **Minimum Population Estimate**

The survey technique utilized for estimating the abundance of beluga whales is a direct count which incorporates correction factors. Although CVs of the correction factors are not available, the Alaska Scientific Review Group concluded that the population estimate of 3,710 can serve as an estimate of minimum population size because the survey did not include areas where beluga are known to occur (Small and DeMaster 1995). That is, if the distribution of beluga whales in the eastern Chukchi Sea is similar to the distribution of beluga whales in the Beaufort Sea, which is likely based on satellite tag results (Suydam et al. 2001, Lowry and Frost 2002), then a substantial fraction of the population was likely to have been in offshore waters during the survey period (DeMaster 1997).

### **Current Population Trend**

The maximum 1998 count (1,172 animals) is similar to counts of beluga whales conducted in the same area during the summers of 1989-91 (1,200 animals) and counts of 1,104 and 1,601 in the summer of 1979 (Frost et al. 1993, DeMaster et al. 1998). Based on these data, there is no evidence that the eastern Chukchi Sea stock of beluga whales is declining.

### **CURRENT AND MAXIMUM NET PRODUCTIVITY RATES**

A reliable estimate of the maximum net productivity rate is currently unavailable for this stock of beluga whales. Hence, until additional data become available, it is recommended that the cetacean maximum theoretical net productivity rate ( $R_{MAX}$ ) of 4% be employed for this stock (Wade and Angliss 1997).

### **POTENTIAL BIOLOGICAL REMOVAL**

Under the 1994 reauthorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor:  $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$ . This stock is considered relatively stable and not declining in the presence of known take, thus the recovery factor ( $F_R$ ) for this stock is 1.0 (DeMaster 1995, Wade and Angliss 1997). For the eastern Chukchi Sea stock of beluga whales,  $PBR = 74$  animals ( $3,710 \times 0.02 \times 1.0$ ).

### **ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY**

#### **Fisheries Information**

Three different commercial fisheries that could have interacted with beluga whales from this stock were monitored for incidental take by fishery observers during 1990-97: Bering Sea (and Aleutian Islands) groundfish trawl, longline, and pot fisheries. Observers did not report any mortality or serious injury of beluga whales incidental to these groundfish fisheries. An additional source of information on the number of beluga whales killed or injured incidental to commercial fishery operations is the self-reported fisheries information required of vessel operators by the MMPA. During the period between 1990 and 1997, fisher self-reports did not include any mortality to beluga whales from this stock as a result of interactions with commercial fishing operations. Self-reported fisheries data are incomplete for 1994, not available for 1995, and considered unreliable after 1995 (see Appendix 7 for details).

In the near shore waters of the southeastern Chukchi Sea, substantial effort occurs in gillnet (mostly set nets), and personal-use fisheries. Although a potential source of mortality, there have been no reported takes of beluga whales as a result of these fisheries.

Based on a lack of reported mortalities, the estimated minimum mortality rate incidental to commercial fisheries is zero belugas per year from this stock.

### Subsistence/Native Harvest Information

The subsistence take of beluga whales from the eastern Chukchi Sea stock is provided by the Alaska Beluga Whale Committee (ABWC). The most recent subsistence harvest estimates for the stock are provided in Table 1422 (Frost and Suydam 1995, Frost 1998, Frost 2003, Frost pers. comm., 2001-2004). Given these data, the annual subsistence take by Alaska Natives averaged 6065 belugas during the 5-year period 1996-2000/1999-2003 based on reports from ABWC representatives and on-site harvest monitoring. The 1993-95/2003 data are for all sites and all years negatively biased because reliable estimates for the number of animals struck and lost are not available prior to 1996.

**Table 1422.** Summary of the Alaska Native subsistence harvest from the eastern Chukchi Sea stock of beluga whales, 1993-2003. n/a indicates the data are not available.

Year	Reported total number taken	Estimated range of total take	Reported number harvested	Estimated number struck and lost
1993	83 <sup>+</sup>	n/a	80-83	n/a
1994	66 <sup>2</sup>	n/a	63	3 <sup>2</sup>
1995	42	n/a	36	6
1996	126	n/a	116	10
1997	19	n/a	16	3
1998	96	n/a	91	5
1999	52	n/a	52	0
2000	5	n/a	2	3
2001	89	n/a	84	5
2002	99	n/a	93	6
2003	78	n/a	74	4
Mean annual take (1996-2000/1999-2003)	6065			

<sup>+</sup> Does not include the number struck and lost; <sup>2</sup> Indicates a lower bound.

### STATUS OF STOCK

The estimated minimum annual mortality rate incidental to commercial fisheries (0) is not known to exceed 10% of the PBR (7) and, therefore, is considered to be insignificant and approaching zero mortality and serious injury rate. Based on currently available data, the estimated annual rate of human-caused mortality and serious injury (6065) is not known to exceed the PBR (74). Eastern Chukchi Sea Beluga whales are not listed as “depleted” under the MMPA or listed as “threatened” or “endangered” under the Endangered Species Act. Therefore, the eastern Chukchi Sea stock of beluga whales is not classified as a strategic stock. The population size is considered stable; however, at this time it is not possible to assess the status of this stock relative to its Optimum Sustainable Population size.

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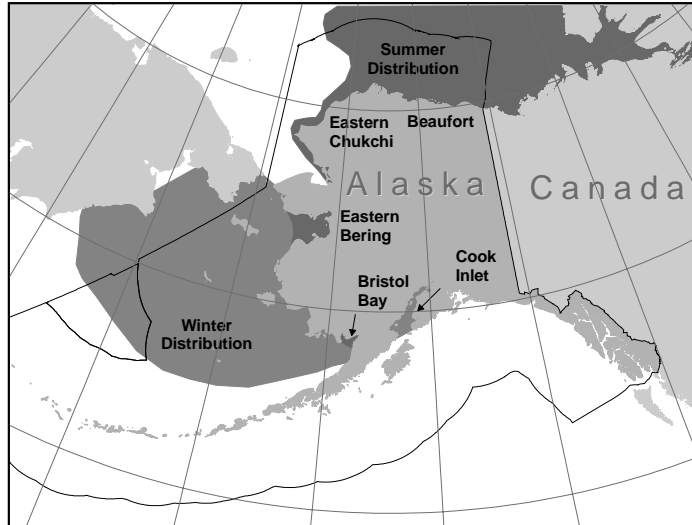
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## BELUGA WHALE (*Delphinapterus leucas*): Eastern Bering Sea Stock

### STOCK DEFINITION AND GEOGRAPHIC RANGE

Beluga whales are distributed throughout seasonally ice-covered arctic and subarctic waters of the Northern Hemisphere (Gurevich 1980), and are closely associated with open leads and polynyas in ice-covered regions (Hazard 1988). Depending on season and region, beluga whales may occur in both offshore and coastal waters, with concentrations in Cook Inlet, Bristol Bay, Norton Sound, Kasegaluk Lagoon, and the Mackenzie Delta (Hazard 1988). It is assumed that most beluga whales from these summering areas overwinter in the Bering Sea, excluding those found in the northern Gulf of Alaska (Shelden 1994). Seasonal distribution is affected by ice cover, tidal conditions, access to prey, temperature, and human interaction (Lowry 1985). During the winter, beluga whales occur in offshore waters associated with pack ice. In the spring, they migrate to warmer coastal estuaries, bays, and rivers for molting (Finley 1982) and calving (Sergeant and Brodie 1969). Annual migrations may cover thousands of kilometers (Reeves 1990).



**Figure 4617.** Approximate distribution of beluga whales in Alaska waters. The dark shading displays the summer distribution of the five stocks. Winter distributions are depicted with lighter shading.

The following information was considered in classifying beluga whale stock structure based on the Dizon et al. (1992) phylogeographic approach: 1) Distributional data: geographic distribution discontinuous in summer (Frost and Lowry 1990), distribution unknown outside of summer; 2) Population response data: possible extirpation of local populations; distinct population trends between regions occupied in summer; 3) Phenotypic data: unknown; and 4) Genotypic data: mitochondrial DNA analyses indicate distinct differences among summering areas (O'Corry-Crowe et al. 1997). Based on this information, 5 stocks of beluga whales are recognized within U. S. waters: 1) Cook Inlet, 2) Bristol Bay, 3) eastern Bering Sea, 4) eastern Chukchi Sea, and 5) Beaufort Sea (Fig. 4617).

### POPULATION SIZE

DeMaster et al. (1994) estimated the minimum abundance (e.g., uncorrected for probability of sighting) of belugas from aerial surveys over Norton Sound in 1992, 1993, and 1994 at 2,095, 620, and 695, respectively (see also Lowry et al. 1995). The variation between years was due, in part, to variability in the timing of the migration and movement of animals into the Sound. As a result the 1993 and 1994 estimates were considered to be negatively biased. Due to the disparity of estimates, the Norton Sound aerial surveys were repeated in June of 1995 leading to the highest abundance estimate of any year, but not significantly different than in 1992. An aerial survey conducted June 22 of 1995 resulted in an uncorrected estimate of 2,583 beluga whales (Lowry and DeMaster 1996). It should be noted that a slightly higher estimate (2,666) occurred during the 1995 survey over 3-day period from June 6-8. The single day estimate of (2,583), instead of the 3-day estimate was used to minimize the potential for double counting of whales. Correction factors (CF) recommended from studies of belugas range from 2.5 to 3.27 (Frost and Lowry 1995). For Norton Sound, the correction factor of 2.62 (CV [CF] not available) is recommended for the proportion of animals that were diving and thus not visible at the surface (based on methods of Frost and Lowry 1995), given the particular altitude and speed of the survey aircraft. If this correction factor is applied to the June 22 estimate of 2,583 (CV = 0.26) along with the additional correction factor for the proportion of newborns and yearlings not observed due to their small size and dark coloration (1.18; Brodie 1971), the total corrected abundance estimate for the eastern Bering Sea stock is 7,986 ( $2,583 \times 2.62 \times 1.18$ ) beluga whales.

Aerial surveys of Norton Sound were also conducted in 2000. Preliminary analyses indicate that the uncorrected estimate was 5,868 animals; when corrected for animals not visible at the surface and for newborn and



yearling animals not observed due to their small size and dark coloration, the estimated population size for Norton Sound is 18,142 (CV = 0.24; R. Hobbs, AFSC-NMML, National Marine Mammal Laboratory, 7600 Sand Point Way NE, Seattle, WA 98115 pers. comm.).

### Minimum Population Estimate

For the eastern Bering Sea stock of beluga whales, the minimum population estimate ( $N_{\text{MIN}}$ ) is calculated according to Equation 1 from the PBR Guidelines (Wade and Angliss 1997). Therefore,  $N_{\text{MIN}} = N/\exp(0.842 \times [\ln(1 + [CV(N)]^2)]^{1/2})$ . Using the population estimate (N) of 18,142 and an associated CV(N) of 0.24,  $N_{\text{MIN}}$  for this stock is 14,898 beluga whales. A CV(N) that incorporates variance due to all of the correction factors is currently not available. However, the Alaska Scientific Review Group (SRG) considers the CV derived from the abundance estimate (CV = 0.24) as adequate in calculating a minimum population estimate (DeMaster 1996, 1997; see discussion of  $N_{\text{MIN}}$  for the eastern Chukchi stock of beluga whales).

### Current Population Trend

Surveys to estimate population abundance in Norton Sound were not conducted prior to 1992. Annual estimates of population size from surveys flown in 1992-95 and 1999-2000 have varied widely, due partly to differences in survey coverage and conditions between years. Data currently available do not allow an evaluation of population trend for the Eastern Bering Sea stock.

### CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently unavailable for the eastern Bering Sea stock of beluga whales. Hence, until additional data become available, it is recommended that the cetacean maximum theoretical net productivity rate ( $R_{\text{MAX}}$ ) of 4% be employed for this stock (Wade and Angliss 1997).

### POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 reauthorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor:  $PBR = N_{\text{MIN}} \times 0.5R_{\text{MAX}} \times F_R$ . The recovery factor ( $F_R$ ) for this stock is 1.0, the value for cetacean stocks that are thought to be stable in the presence of a subsistence harvest (Wade and Angliss 1997). The Alaska SRG recommended using a  $F_R$  of 1.0 for this stock as the Alaska Beluga Whale Committee (ABWC) intends to continue regular surveys (i.e., 3-5 years) to estimate abundance for this stock and to annually monitor levels of subsistence harvest (DeMaster 1997). For the eastern Bering Sea stock of beluga whales,  $PBR = 298$  animals ( $14,898 \times 0.02 \times 1.0$ ).

### ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

#### Fisheries Information

~~Three different commercial fisheries that could have interacted with beluga whales in the eastern Bering Sea were monitored for incidental take by fishery observers during 1990-97: Bering Sea (and Aleutian Islands) groundfish trawl, longline, and pot fisheries. Observers did not report any mortality or serious injury of beluga whales incidental to these groundfish fisheries.~~ In previous assessments, there were three different federally observed commercial fisheries in Alaska that could have had incidental serious injuries or mortalities of eastern Bering Sea beluga whales. In 2004, the definitions of these commercial fisheries were changed to reflect target species; this new definition has resulted in the identification of several observed fisheries in the Bering Sea that use trawl, longline, or pot gear. There have been no observed serious injuries or mortalities in any of these commercial fisheries. An additional source of information on the number of beluga whales killed or injured incidental to commercial fishery operations is the self-reported fisheries information required of vessel operators by the MMPA. During the period between 1990 and 1997, fisher self-reports did not include any mortality to beluga whales from this stock as a result of interactions with commercial fishing operations. Self-reported fisheries data are incomplete for 1994, not available for 1995, and considered unreliable after 1995 (see Appendix 7).

Based on a lack of reported mortalities, the estimated minimum mortality rate incidental to commercial fisheries is zero belugas per year from this stock. The estimated mortality is considered a minimum due to a lack of observer programs in fisheries likely to take beluga whales and because logbook records (fisher self-reports required during 1990-94) are most likely negatively biased (Credle et al. 1994).

In the near shore waters of the eastern Bering Sea, substantial effort occurs in gillnet (mostly set nets), herring, and personal-use fisheries. The only reported beluga mortality in this region occurred in a personal-use king salmon gillnet near Cape Nome in 1996. This mortality results in an annual estimated mortality of 0.2 whales from this stock during 1996-2000. Note that this is not a commercial fishery. As a result, this estimate is considered a minimum because personal-use fishers are not aware of a reporting requirement and there is no established protocol for non-commercial takes to be reported to NMFS. It should also be noted that in this region of western Alaska, any whales taken incidentally to the personal-use fishery are utilized by Alaska Native subsistence users. It is not clear whether the 1996 entanglement was accounted for in the 1996 Alaska Native subsistence harvest report. If so, this particular mortality may have been double-counted. NMFS assumes that all beluga whales taken for subsistence use, regardless of the method of harvest, are reported to the ABWC and are reflected in the following section on Subsistence/Native Harvest Information; however, some underreporting is known to occur (SRG, November 2004).

### Subsistence/Native Harvest Information

The subsistence take of beluga whales from the eastern Bering Sea stock is provided by the ABWC. The most recent subsistence harvest estimates for the stock are provided in Table 4523 (Frost and Suydam 1995, Frost 1998, Frost 2003, Frost pers. comm. 2001-2004). Given these data, the annual subsistence take by Alaska Natives averaged 164209 belugas from the eastern Bering Sea stock during the 5-year period 1996-2000. 1999-2003 estimates are based on reports from ABWC representatives. The 1993-97 data are considered negatively biased due to a lack of reporting in several villages prior to 1996. In addition, there is not a reliable estimate for the number of struck and lost prior to 1996. Furthermore, an unknown proportion of the animals harvested each year by Alaska Native hunters in this region may belong to other beluga stocks migrating through Norton Sound in both the fall and spring (DeMaster 1995).

**Table 4523.** Summary of the Alaska Native subsistence harvest from the eastern Bering Sea stock of beluga whales, 1993-2000. n/a indicates the data are not available.

Year	Reported total number taken	Estimated range of total take	Reported number harvested	Estimated number struck and lost
1993	136 <sup>1,2</sup>	121-136 <sup>1</sup>	121-136	n/a
1994	132 <sup>2</sup>	126-132 <sup>2</sup>	116-122	10 <sup>2</sup>
1995	56 <sup>2</sup>	51-61 <sup>2</sup>	45-55 <sup>2</sup>	6 <sup>2</sup>
1996	120	113-126	97-108	16-18
1997	160	146-173	127-141	19-32
1998	168	n/a	143	27
1999	159	n/a	134	25
2000	212	n/a	188	24
2001	309	n/a	281	28
2002	255	n/a	234	21
2003	109		101	8
Mean annual take (1996-2000/1999-2003)	164209			

<sup>1</sup> Does not include the number struck and lost; <sup>2</sup> Indicates a lower bound.

### STATUS OF STOCK

The estimated minimum annual mortality rate incidental to commercial fisheries (0) is not known to exceed 10% of the PBR (30) and, therefore, is considered to be insignificant and approaching zero mortality and serious injury rate. Based on currently available data, the estimated annual rate, over the 5-year period from 1996-00/1999-2003, of human-caused mortality and serious injury (164209, including the estimated mortality in non-commercial fisheries) is not known to exceed the PBR (298) for this stock. Eastern Bering Sea beluga whales are not listed as “depleted” under the MMPA or listed as “threatened” or “endangered” under the Endangered Species Act. Therefore, the eastern Bering Sea beluga whale stock is not classified as strategic. No decreasing trend has been detected for this stock in the presence of a known harvest, although at this time it is not possible to assess the status of this stock relative to its Optimum Sustainable Population size.

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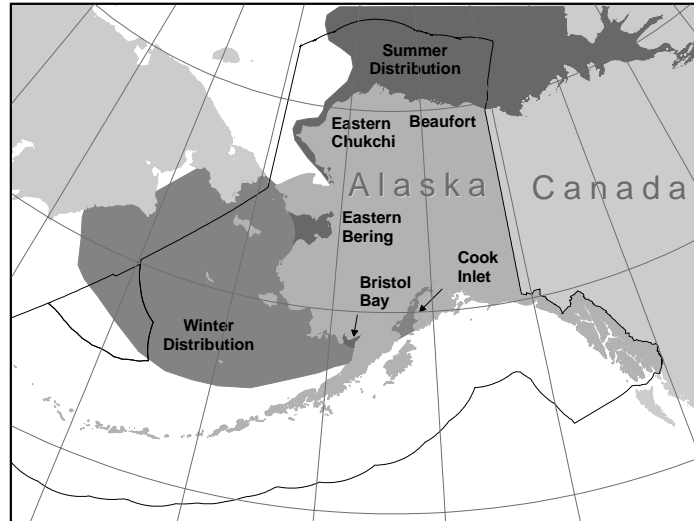
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## BELUGA WHALE (*Delphinapterus leucas*): Bristol Bay Stock

### STOCK DEFINITION AND GEOGRAPHIC RANGE

Beluga whales are distributed throughout seasonally ice-covered arctic and subarctic waters of the Northern Hemisphere (Gurevich 1980), and are closely associated with open leads and polynyas in ice-covered regions (Hazard 1988). Depending on season and region, beluga whales may occur in both offshore and coastal waters, with concentrations in Cook Inlet, Bristol Bay, Norton Sound, Kassegaluk Lagoon, and the Mackenzie Delta (Hazard 1988). It is assumed that most beluga whales from these summering areas overwinter in the Bering Sea, excluding those found in the northern Gulf of Alaska (Shelden 1994). Seasonal distribution is affected by ice cover, tidal conditions, access to prey, temperature, and human interaction (Lowry 1985). During the winter, beluga whales occur in offshore waters associated with pack ice. In the spring, they migrate to warmer coastal estuaries, bays, and rivers for molting (Finley 1982) and calving (Sergeant and Brodie 1969). Annual migrations may cover thousands of kilometers (Reeves 1990).



**Figure 4718.** Approximate distribution of beluga whales in Alaska waters. The dark shading displays the summer distribution of the five stocks. Winter distributions are depicted with lighter shading.

The following information was considered in classifying beluga whale stock structure based on the Dizon et al. (1992) phylogeographic approach: 1) Distributional data: geographic distribution discontinuous in summer (Frost and Lowry 1990), distribution unknown outside of summer; 2) Population response data: possible extirpation of local populations; distinct population trends between regions occupied in summer; 3) Phenotypic data: unknown; and 4) Genotypic data: mitochondrial DNA analyses indicate distinct differences among summering areas (O'Corry-Crowe et al. 1997). Based on this information, 5 stocks of beluga whales are recognized within U. S. waters: 1) Cook Inlet, 2) Bristol Bay, 3) eastern Bering Sea, 4) eastern Chukchi Sea, and 5) Beaufort Sea (Fig. 4718).

### POPULATION SIZE

The sources of information to estimate abundance for belugas in the waters of western and northern Alaska have included both opportunistic and systematic observations. Frost and Lowry (1990) compiled data collected from aerial surveys conducted between 1978 and 1987 that were designed to specifically estimate the number of beluga whales. Surveys did not cover the entire habitat of belugas, but were directed to specific areas at the times of year when belugas were expected to concentrate. Frost and Lowry (1990) reported an estimate of 1,000-1,500 for Bristol Bay, similar to that reported by Seaman et al. (1985). Most recently, the number of beluga whales in Bristol Bay was estimated at 1,555 in 1994 (Lowry and Frost 1998). This estimate was based on a maximum count of 503 animals, which was corrected using radio-telemetry data for the proportion of animals that were diving and thus not visible at the surface (2.62, Frost and Lowry 1995b), and for the proportion of newborns and yearlings not observed due to their small size and dark coloration (1.18; Brodie 1971). Surveys flown by the ADF&G in 1999 and 2000 resulted in maximum counts of 690 and 531, which can be extrapolated to provide population estimates of 2,133 and 1,642, respectively (L. Lowry, pers comm.). The Alaska Beluga Whale Committee conducted beluga surveys in Bristol Bay in 2004 and will do so again in 2005.

### Minimum Population Estimate

The survey technique used for estimating the abundance of beluga whales in this stock is a direct count which incorporates correction factors. Given this survey methodology, estimates of the variance of abundance are

unavailable. In addition, the abundance estimate is thought to be conservative because 1) some whales may have been outside the survey area (i.e., Kuskokwim Bay), 2) no correction has been made for whales that were at the surface but were missed by the observers, and 3) the dive correction factor is probably negatively biased (Lowry and Frost 1998). Consistent with the recommendations of the Alaska Scientific Review Group (DeMaster 1997), a default CV(N) of 0.2 was used in the calculation of the minimum population estimate ( $N_{\text{MIN}}$ ).  $N_{\text{MIN}}$  for this beluga whale stock is calculated using Equation 1 from the PBR Guidelines (Wade and Angliss 1997):  $N_{\text{MIN}} = N / \exp(0.842 \times [\ln(1 + [\text{CV}(N)]^2)]^{1/2})$ . Using the average estimate for 1999 and 2000 of (N) of 1,888 and the default CV (0.2),  $N_{\text{MIN}}$  for the Bristol Bay stock of beluga whales is 1,619.

### **Current Population Trend**

Population estimates from the 1950s (Brooks 1955, Lensink 1961) suggested there were about 1,000-1,500 belugas in Bristol Bay. The first abundance estimate (1,250) from aerial surveys was conducted in 1983. Consistency in count data and abundance estimates between 1993, 1994, and earlier surveys (Frost and Lowry 1990, 1995a; Lowry and Frost 1998), and the higher counts in 1999 and 2000 suggests that the Bristol Bay stock is at least stable, and may be increasing.

### **CURRENT AND MAXIMUM NET PRODUCTIVITY RATES**

A reliable estimate of the maximum net productivity rate is currently unavailable for the Bristol Bay stock of beluga whales. Hence, until additional data become available, it is recommended that the cetacean maximum theoretical net productivity rate ( $R_{\text{MAX}}$ ) of 4% be employed for this stock (Wade and Angliss 1997).

### **POTENTIAL BIOLOGICAL REMOVAL**

Under the 1994 reauthorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor:  $\text{PBR} = N_{\text{MIN}} \times 0.5R_{\text{MAX}} \times F_R$ . As this stock is considered stable (Frost and Lowry 1990) and because of the regular surveys to estimate abundance and the annual harvest monitoring program supported by the Alaska Beluga Whale Committee (ABWC), the recovery factor ( $F_R$ ) for this stock is 1.0 (Wade and Angliss 1997, DeMaster 1997; see discussion under PBR for the eastern Bering Sea stock). Thus, for the Bristol Bay stock of beluga whales,  $\text{PBR} = 32$  animals ( $1,619 \times 0.02 \times 1.0$ ).

### **ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY**

#### **Fisheries Information**

Three different commercial fisheries that could have interacted with beluga whales in Bristol Bay were monitored for incidental take by fishery observers during 1990-97: Bering Sea (and Aleutian Islands) groundfish trawl, longline, and pot fisheries. Observers did not report any mortality or serious injury of beluga whales incidental to these groundfish fisheries (Table 46a24).

An additional source of information on the number of beluga whales killed or injured incidental to commercial fishery operations is the self-reported fisheries information required of vessel operators by the MMPA. Observers have never monitored the Bristol Bay salmon set gillnet and drift gillnet fisheries which combined had over 2,900 active permits in 1996. During the period between 1990-2000, fisher self-reports included 1 mortality in both 1990 and 1991 from these fisheries (see Table 46a24) resulting in an annual mean of 0.5 mortalities from interactions with commercial gear. However, because logbook records (fisher self-reports required during 1990-94) are most likely negatively biased (Credle et al. 1994), these are considered to be minimum estimates. The 1990 logbook records from the Bristol Bay set and drift gillnet fisheries were combined. As a result, the 1990 mortality may have occurred in the drift net fishery. Self-reported fisheries data are incomplete for 1994, not available for 1995, and considered unreliable after 1995 (see Appendix 7). Larger fishery-related mortalities resulting from these fisheries have been recorded in the past. During the summer of 1983 the Alaska Department of Fish and Game documented 12 beluga whale mortalities in Bristol Bay related to drift and set gillnet fishing (Frost et al. 1984).



**Table 16a24** Summary of incidental mortality of beluga whales (Bristol Bay stock) due to commercial fisheries from 1990-2000<sup>3</sup> and calculation of the mean annual mortality rate. Mean annual mortality in brackets represents a minimum estimate from self-reported fisheries information. ~~Data from 1996-2000 (or the most recent 5 years of available data) are used in the mortality calculation when more than 5 years of data are provided for a particular fishery.~~ n/a indicates that data are not available.

Fishery name	Years	Data type	Range of observer coverage	Reported mortality (in given yrs.)	Estimated mortality (in given yrs.)	Mean annual mortality
Observer program total	90-00					0
Bristol Bay salmon drift gillnet	90-00 <sup>3</sup>	self reports	n/a	0, 1, 0, 0; n/a, n/a, n/a; n/a, n/a, n/a; n/a 1994-03: n/a	n/a	[≥0.25]
Bristol Bay salmon set gillnet	90-00 <sup>3</sup>	self reports	n/a	1, 0, 0, 0; n/a, n/a, n/a; n/a, n/a, n/a; n/a 1994-03: n/a	n/a	[≥0.25]
Minimum total annual mortality						≥0.5

The estimated minimum mortality rate incidental to commercial fisheries is 1 animal per year (rounded up from 0.5), based entirely on logbook data. However, a reliable estimate of the mortality rate incidental to commercial fisheries is currently unavailable because of the absence of observer placements in the Bristol Bay gillnet fisheries that are known to interact with this stock.

#### Subsistence/Native Harvest Information

Data on the subsistence take of beluga whales from the Bristol Bay stock is provided by the ABWC. The most recent subsistence harvest estimates for the stock are provided in Table 16b25 (Frost and Suydam 1995, Frost 1998, Frost, pers. comm. 2001<sup>2</sup>2004). Given these data, the annual subsistence take by Alaska Natives averaged ~~15~~<sup>19</sup> belugas from the Bristol Bay stock during the 5-year period ~~1996-2000~~<sup>1999-2003</sup>. This estimate is based on reporting by ABWC representatives and is considered negatively biased because there is not a reliable estimate for the number of struck and lost ~~prior to 1994~~<sup>in 2001 and 2002</sup>.

**Table 16b25** Summary of the Alaska Native subsistence harvest from the Bristol Bay stock of beluga whales, 1993<sup>2</sup>-2000<sup>3</sup>. n/a indicates the data are not available.

Year	Reported total number taken	Estimated range of total take	Reported number harvested	Estimated number struck and lost
1993	35 <sup>+</sup>	33-35 <sup>+</sup>	33-35	n/a
1994	18	n/a	16	2
1995	10	n/a	6	4
1996	19	n/a	18	1
1997	11	n/a	11	0
1998	7	n/a	6	1
1999	15	n/a	13	2
2000	25	n/a	24 <sup>2</sup>	1
2001	22 <sup>1</sup>	n/a	22	n/a
2002	9 <sup>1</sup>	n/a	9	n/a
2003	24		21	3
Mean annual take (1996-2000 <sup>3</sup> 1999-2003)	15 <sup>19</sup>			

<sup>1</sup> Does not include the number struck and lost.

<sup>2</sup> May include beluga taken in subsistence drift gillnet fishing for salmon.

There is substantial effort in a subsistence gillnet fishery for salmon in Bristol Bay. There were 76 reported mortalities of beluga in subsistence salmon gillnet fisheries in 2000 and one reported mortality of a beluga whale in a subsistence gillnet in 2002. If this level of mortality is averaged over 5 years, an average of 1.4 beluga per year would be caught in subsistence gillnet fisheries in this area. In addition, records indicate that one and two beluga whales were killed incidental to a commercial salmon set nets in 2000 and 2002, and these animals were used for subsistence purposes. Thus, the total subsistence harvest resulting from net entanglements is 2 beluga per year. However, it is not clear whether the “sudden” increase of mortalities in 2000 is a result of an actual increase or an increase in reporting such events. Note that these mortalities did not occur incidental to a commercial fishery, or did occur incidental to a commercial fishery and were used for subsistence purposes. As a result, this estimate is considered a minimum because personal-use fishers are not aware of a reporting requirement and there is no established protocol for non-commercial takes to be reported to NMFS. It should also be noted that in this region of western Alaska any whales taken incidentally to the personal-use fishery are utilized by Alaska Native subsistence users. It is not clear whether the mortalities reported in 2000 and 2002 are accounted for in the 2000 and 2002 Alaska Native subsistence harvest report; the subsistence harvest report will be used to document the reported take of beluga whales in Bristol Bay. If so, this particular mortality may have been double counted.

## STATUS OF STOCK

At present, annual mortality levels less than 3.2 per year (i.e., 10% of PBR) can be considered insignificant and approaching zero mortality and serious injury rate. However, it is unknown whether the mortality rate is insignificant because a reliable estimate of the mortality rate incidental to commercial fisheries is currently unavailable. Bristol Bay beluga whales are not listed as “depleted” under the MMPA or listed as “threatened” or “endangered” under the Endangered Species Act. Based on currently available data, the estimated annual rate of human-caused mortality and serious injury (4619.5, including fishery-related mortality and subsistence harvest) is not known to exceed the PBR (32). Therefore, the Bristol Bay stock of beluga whales is not classified as a strategic stock. However, as noted previously, the estimate of fisheries-related mortality is unreliable and, therefore, likely to be underestimated. The population size is considered stable, however, at this time it is not possible to assess the status of this stock relative to its Optimum Sustainable Population size.

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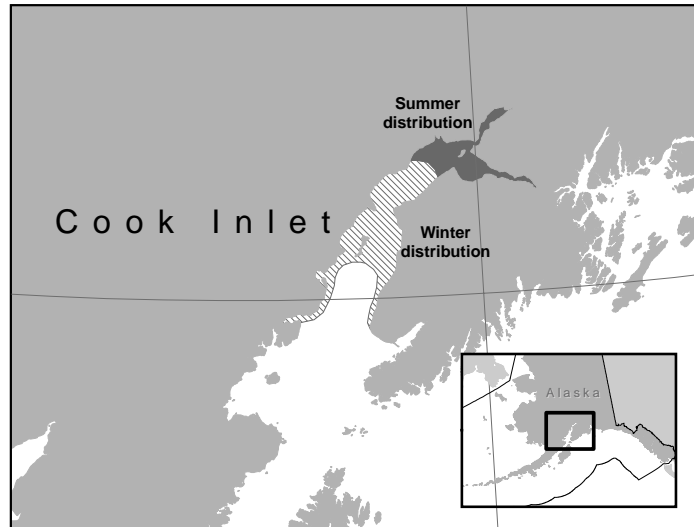
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## BELUGA WHALE (*Delphinapterus leucas*): Cook Inlet Stock

### STOCK DEFINITION AND GEOGRAPHIC RANGE

Beluga whales are distributed throughout seasonally ice-covered arctic and subarctic waters of the Northern Hemisphere (Gurevich 1980), and are closely associated with open leads and polynyas in ice-covered regions (Hazard 1988). Depending on season and region, beluga whales may occur in both offshore and coastal waters, with concentrations in Cook Inlet, Bristol Bay, Norton Sound, Kasegaluk Lagoon, and the Mackenzie Delta (Hazard 1988). Apparently most beluga whales from these summering areas overwinter in the Bering Sea, excluding those found in Cook Inlet (O'Corry-Crowe et al. 1997). Seasonal distribution is affected by ice cover, tidal conditions, access to prey, temperature, and human interaction (Lowry 1985). During the winter, beluga whales occur in offshore waters associated with pack ice. In the spring, many migrate to warmer coastal estuaries, bays, and rivers for molting (Finley 1982) and calving (Sergeant and Brodie 1969). Annual migrations may cover thousands of kilometers (Reeves 1990, Suydam et al. 2001).



**Figure 1819.** Approximate distribution of beluga whales in Alaska waters Cook Inlet. The dark shading displays the summer distribution of the five stocks. Winter distributions are is depicted with lighter dashed shading.

During spring and summer months, beluga whales in Cook Inlet are typically concentrated near river mouths in northern Cook Inlet (Rugh et al. 2000). Although the exact winter distribution of this stock is unknown, there is evidence that some--if not all--of this population may inhabit Cook Inlet year-round (Fig. 19) (Hansen and Hubbard 1999, Rugh et al. 2000). Satellite tags have been attached to nine 17 belugas in late summer in order to determine their distribution through the fall and winter. Of these, six Ten tags have lasted through the fall and one lasted into March of those, three have lasted through the winter. The three tags that transmitted through the winter stopped working in April and late May (Hobbs et al. in review). None tagged beluga have gone moved south of Chinitna Bay (Hobbs et al. in review). A review of all cetacean surveys conducted in the Gulf of Alaska from 1936-2000 discovered only 31 sightings of belugas among 23,000 sightings of other cetaceans, indicating that very few belugas occur in the Gulf of Alaska outside of Cook Inlet (Laidre et al. 2000). A small number of beluga whales (under 20 animals) also occur at least seasonally in Yakutat Bay; these are considered part of the Cook Inlet stock (65 FR 34590; 31 May 2000).

The following information was considered in classifying beluga whale stock structure based on the Dizon et al. (1992) phylogeographic approach: 1) Distributional data: geographic distribution discontinuous in summer (Frost and Lowry 1990); distribution unknown outside of summer; 2) Population response data: possible extirpation of local populations; distinct population trends between regions occupied in summer; 3) Phenotypic data: unknown; and 4) Genotypic data: mitochondrial DNA analyses indicate distinct differences among summering areas (O'Corry-Crowe et al. 1997, 2002). Based on this information, 5 stocks of beluga whales are recognized within U. S. waters: 1) Cook Inlet, 2) Bristol Bay, 3) eastern Bering Sea, 4) eastern Chukchi Sea, and 5) Beaufort Sea (Fig. 1819).

### POPULATION SIZE

Aerial surveys for beluga whales in Cook Inlet have been conducted by the National Marine Fisheries Service each year since 1993. Starting in 1994, the survey protocol included paired, independent observers so that the number of whale groups missed can be estimated. When groups were seen, a series of aerial passes were made to allow each observer to make independent counts at the same time that a video camera was documenting photographing the whale group (Rugh et al. 2000).

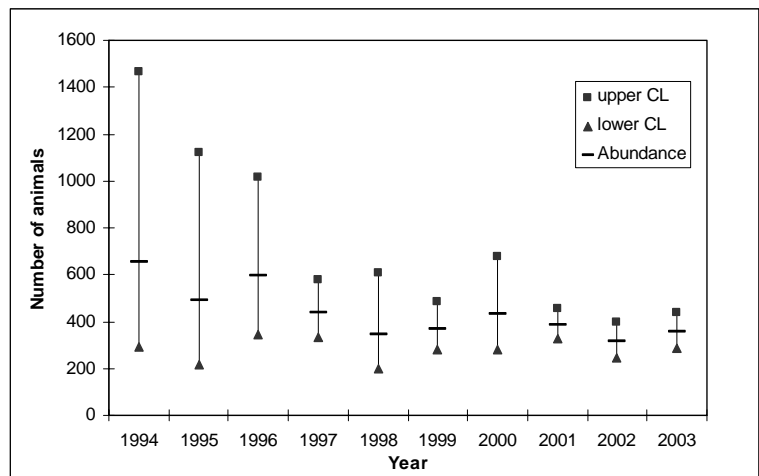
The annual abundances of beluga whales in Cook Inlet are estimated from counts by aerial observers and aerial video group counts. Each group size estimate is corrected for subsurface animals (availability correction) and animals at the surface that were missed (sightability correction) based on an analysis of the video tapes (Hobbs et al. 2000b). ~~Each~~ When video counts are not available, observer's counts are corrected for availability and sightability using a regression of counts and an interaction term of counts with encounter rate against the video group size estimates (Hobbs et al. 2000b). The most recent abundance estimate of beluga whales in Cook Inlet, resulting from the June 2001-2003 aerial survey is 386 (CV = 0.087) 357 (CV = 0.107) animals (NMFS unpubl. data). ~~Although the 2001-2003 estimate of abundance is slightly lower than~~ similar to the estimates for 1999 and 2000, the difference from estimates in 2001 and 2002 is not significant and is not believed to represent a decline in the population (NMFS unpublished data).

### Minimum Population Estimate

The minimum population size ( $N_{\text{MIN}}$ ) for this stock is calculated according to Equation 1 from the PBR Guidelines (Wade and Angliss 1997):  $N_{\text{MIN}} = N / \exp(0.842 \times [\ln(1 + [\text{CV}(N)]^2)]^{1/2})$ . Using the population estimate (N) of 386 357 and its associated CV(N) of 0.087 0.107,  $N_{\text{MIN}}$  for the Cook Inlet stock of beluga whales is 359 326.

### Current Population Trend

~~In general, uncorrected counts have ranged from 300 to 500 beluga whales within Cook Inlet between 1970 and 1996 (Rugh et al. 2000). However, median counts since 1996 have been below 300 animals (264 in 1997, 193 in 1998, 217 in 1999, and 184 in 2000). The corrected abundance estimates for the period 1994-2003 are shown in Figure 19 20. A statistically significant trend in abundance was detected between 1994 and 1998 (Hobbs et al. 2000a), although the power was low due to the short time series. However, the 1998 abundance estimate (349) was approximately 50% lower than the 1994 abundance estimate (653). In addition, a review of beluga distribution data over the past three decades shows there has been a reduction in offshore sightings in upper Cook Inlet and a dramatic reduction in sightings in lower Cook Inlet (Rugh et al. 2000). Since 1998, this decline seems to have stopped. The Cook Inlet beluga population has shown no significant trend since 1998 (Hobbs et al. 2000a) (NMFS unpublished data).~~



**Figure 1220.** Abundance of beluga whales in Cook Inlet, Alaska 1994-2003. Error bars depict 95% confidence intervals.

### CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently not available for the Cook Inlet stock of beluga whales. Hence, until additional data become available, it is recommended that the cetacean maximum theoretical net productivity rate ( $R_{\text{MAX}}$ ) of 4% be employed for this stock (Wade and Angliss 1997).

### POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 reauthorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor:  $PBR = N_{\text{MIN}} \times 0.5R_{\text{MAX}} \times F_R$ . The  $F_R$  and PBR for the Cook Inlet stock of beluga whale were both undetermined in Small and DeMaster (1995), 1.0 and 15 in Hill et al. (1997), and 1.0 and 14 in Hill and DeMaster (1998). However, based on the recent information on stock size, trends in abundance, and level of the subsistence harvest, the Alaska Scientific Review Group (SRG) (Ferrero 1999) has recommended that NMFS reduce the  $F_R$  to the lowest value possible (0.1) (Ferrero 1999). Further, the Alaska SRG noted the resulting PBR would be 0.61 (assuming an  $N_{\text{MIN}}$  of 303 as the 1999 population size and an  $R_{\text{MAX}}$  of 0.04) and recommended

that the agency use this value in managing interactions between Cook Inlet belugas and commercial fisheries in Cook Inlet.

NMFS has chosen not to accept the recommendation of the Alaska SRG at this time. Rather, NMFS has selected an  $F_R$  of 0.3 based on the following: this stock has been listed as “depleted” under the MMPA (65 Federal Register 34590, 31 May 2000; which typically is associated with a  $F_R$  of 0.5); and NMFS has not listed this stock as endangered under the Endangered Species Act (65 Federal Register 38778, 22 June 2000); a listing of endangered is typically associated with a  $F_R$  of 0.1, while a listing of depleted or threatened is associated with a  $F_R$  of 0.5). Furthermore, the major mortality factor for this stock, subsistence harvest, has been reduced through legislation and cooperative efforts by Alaskan Natives. Thus, the PBR =  $2.2 \times 326 \times 0.02 \times 0.3$  for the Cook Inlet stock of beluga whale.

## ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

### Fisheries Information

In 1999 and 2000, observers were placed on Cook Inlet salmon set and drift gillnet vessels because of the potential for these fisheries to incur incidental mortalities of beluga whales. No mortalities were observed in either year (Merkelein et al., in review; Manly in review). An additional source of information on the number of beluga whales killed or injured incidental to commercial fishery operations is the self-reported fisheries information required of vessel operators by the MMPA. During the period between 1990-2000, fisher self-reports indicated no mortalities of beluga whales from interactions with commercial fishing operations (Table 17a26). Logbook data are available for part of 1989-94, after which incidental mortality reporting requirements were modified. Under the new system, logbooks are no longer required; instead, fishers provide self-reports. Data for the 1994-95 phase-in period is fragmentary. After 1995, the level of reporting dropped dramatically, such that the records are considered incomplete and estimates of mortality based on them represent minimums (see Appendix 7 for details).

**Table 17a26** Summary of incidental mortality of beluga whales (Cook Inlet stock) due to commercial fisheries for 1999-20043.

Fishery name	Years	Data type	Range of observer coverage	Reported mortality (in given yrs.)	Estimated mortality (in given yrs.)	Mean annual mortality
Cook Inlet salmon drift gillnet	1999	obs	1.8%	0	0	0
	2000	data	3.7%	0	0	
Cook Inlet salmon set gillnet	1999	obs	7.3%	0	0	0
	2000	data	8.3%	0	0	
Observer program total	93-99 93-03					0
Minimum total annual mortality						0

Based on a lack of reported mortalities, the estimated minimum mortality rate incidental to commercial fisheries is zero belugas per year from this stock.

### Subsistence/Native Harvest Information

Subsistence harvest of beluga whales in Cook Inlet has been important to local villages. Between 1993 and 1999, the annual subsistence take ranged from 30 animals to over 100 (Mahoney and Shelden 2000). The most thorough subsistence harvest surveys were completed by the Cook Inlet Marine Mammal Council during 1995-97; while some of the hunters believe the 1996 estimate was positively biased, the 1995-97 CIMMC take estimates are considered reliable. The average annual subsistence harvest between 1995 and 1997 was 87 whales.

Because of the decline in the Cook Inlet beluga whale stock in 1999 Congress imposed a moratorium on beluga harvest in Cook Inlet until NMFS developed a cooperative plan for harvest management with the local Alaska Native organizations. Thus, the best estimate of subsistence take in 1999 and 2000 is zero. Harvest is now through 2004 was conducted under an interim harvest management plan developed by a management agreement between the Alaska Native organizations and NMFS (69 FR 17973, 6 April 2004); under that agreement, one whale was taken in both 2001, and 2002, and 2003. A long term harvest management plan is under



development (NMFS 2004). A summary of Cook Inlet beluga whale subsistence harvest data for 1999-2003 is provided in Table 17b27.

**Table 17b27** Summary of the Alaska Native subsistence harvest from the Cook Inlet stock of beluga whales, 1999-2003. n/a indicates the data are not available. Harvest estimates prior to 1999 are not included here because subsistence harvest was drastically limited as of 1999.

Year	Reported total number taken	Estimated range of total take	Reported number harvested	Estimated number struck and lost
1999	0	0	0	0
2000	0	0	0	0
2001	1	-	1	0
2002	1	-	1	0
2003	1	-	1	0
Mean annual take, 2001-03	1			

<sup>+</sup> Estimated value (see text); <sup>-</sup> Represents a minimum value.

## OTHER MORTALITY

Mortalities related to stranding events have been reported in Cook Inlet (Table 28). Since detailed recordkeeping was initiated in 1994, there have been mass strandings of beluga almost every year. These mass strandings resulted in mortalities of 4 animals in 1996, 5 animals in 1999, and 6 animals in 2003 (NMFS unpublished data). In August 1996, 60 beluga whales stranded in Turnagin Arm and four of these animals are known to have died as a result of the stranding event (Moore et al. 2000). In September 1996, 20-30 beluga stranded in Turnagin Arm and one animal died. In August 1999, at least 60 beluga whales stranded in Turnagin Arm, of which five were subsequently found dead (Moore et al. 2000). Many of the strandings occurred in Turnagin Arm. Because Turnagin Arm is a shallow, dangerous waterway, it is not frequented by motorized vessels, and thus, it is highly unlikely that the strandings resulted from human interactions. Another source of mortality in Cook Inlet is killer whale predation. Killer whale sightings were rare in the upper Inlet prior to the 1990s, but have increased to include 18 confirmed sightings from 1985 to 2002 (Shelden et al. 2003). Recently, three predation events occurred in the upper Inlet; one in September 1999 in which the outcome was unknown and one in September 2000 that involved two lactating females which subsequently died (Shelden et al. 2003), and one in 2003 (NMFS unpublished data).

## STATUS OF STOCK

An analysis of available data on the population size and dynamics of the Cook Inlet beluga whale stock led NMFS to conclude that this stock is currently below its Optimum Sustainable Population level. Thus, this stock was designated as “depleted” under the MMPA (65 FR 34590; 31 May 2000). NMFS also made a determination that this stock should not be listed under the ESA at this time (65 FR 38778; 22 June 2000) primarily because the subsistence harvest, which appears to have been responsible for the majority of the decline in this stock, was prohibited in 1999 through an act of Congress. Preliminary results indicate that, once the subsistence harvest ceased, the decline in the stock ceased (65 FR 38778; 22 June 2000, Hobbs et al. 2000a). However, the lack of a significant trend since 1998 indicates that recovery has not yet begun. In addition, NMFS and local subsistence organizations are actively pursuing the development of a co-management agreement which would allow subsistence harvest, but at a level far below historical levels.

Two fisheries suspected of possibly incurring incidental serious injuries or mortalities of beluga whales were observed in 1999 and 2000, but and no takes of beluga whales were observed. At present, annual commercial fishery-related mortality levels can be considered insignificant and approaching zero mortality and serious injury rate. In addition, based on the level of subsistence harvest in 1999 and the fact that there is currently a moratorium on the harvest, the total annual level of human-caused mortality (1.0) does not exceed the PBR (1.82.0) level for this stock. However, because the Cook Inlet beluga whale stock has been designated as “depleted” under the MMPA, the Cook Inlet beluga whale stock is classified as strategic.

Efforts to develop co-management agreements with Native organizations for several marine mammal stocks harvested by Native subsistence hunters across Alaska, including belugas in Cook Inlet, have been underway

for several years. In 1995, development of an umbrella agreement among the Indigenous People's Council for Marine Mammals, U.S. Fish and Wildlife Service, and NMFS was initiated. The agreement was ultimately signed in August 1997. During 1998, efforts were initiated to formalize a specific agreement with local Alaska Native organizations and NMFS regarding the management of Cook Inlet belugas, but without success. In the absence of a co-management agreement, Federal legislation was implemented in May 1999, placing a moratorium on beluga hunting in Cook Inlet until a co-management agreement is completed. Comanagement agreements between NMFS and the Cook Inlet Marine Mammal Council have since been signed in 2000, 2001, and 2002.

### Habitat Concerns

~~NMFS recognizes that municipal, commercial, and industrial activities may be of concern and may affect the water quality and substrate in Cook Inlet. This includes commercial fishing, oil and gas development, municipal discharges, noise for aircraft and ships, shipping traffic, and tourism (Moore et al. 2000). However, no indication currently exists that these activities have had a quantifiable adverse impact on the beluga whale population. The best available information indicates that these activities, alone or~~

~~cumulatively, have not caused the stock to be in danger of extinction (65 FR 38778; 22 June 2000;). Protection from industrial development is being provided at most locations where beluga whales commonly occur. However, susceptibility to adverse impacts may be greater now than previously because the stock, in its currently reduced state, occupies a more restricted portion of its prior range in Cook Inlet.~~

Observation and tagging data both indicate that the northernmost parts of upper Cook Inlet, including the Susitna Delta, Knik Arm, and Chickaloon Bay, are the focus of the stock's distribution in both summer (Rugh et al. 2000) and winter (Hobbs et al. in review). Because of the very restricted range of this stock, Cook Inlet beluga can be assumed to be sensitive to human-induced or natural perturbations in this area of Cook Inlet. Although the best available information indicated that human activities, including oil and gas development, had not caused the stock to be in danger of extinction as of 2000 (65 FR 38778; 22 June 2000), habitat concerns remain. Contaminants from a variety of sources, sound, onshore or offshore development, and construction have the potential to impact this stock or its habitat.

**Table 28.** Cook Inlet beluga strandings investigated by NOAA Fisheries.

Year	Total Dead (includes subsistence)	Natural or Unknown Cause	Number of Belugas Stranded (mortality known)
1994	10	7	186 (0)
1995	12	1	
1996	19	11	63(0), 60(4), 25(0), 10 (0)
1997	6	3	
1998	21	7	30(0), 5(0)
1999	13	13	60(5), 13(0)
2000	13	13 (2 killer whale)	8(0), 15-20(0), 1-2(0)
2001	11	10	
2002	14	13	
2003	21	20 (1 killer whale)	46 (6), 26 (0), 32 (0)
Total	149	98	580-586 (15)

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## **KILLER WHALE (*Orcinus orca*): Eastern North Pacific Alaska Resident Stock**

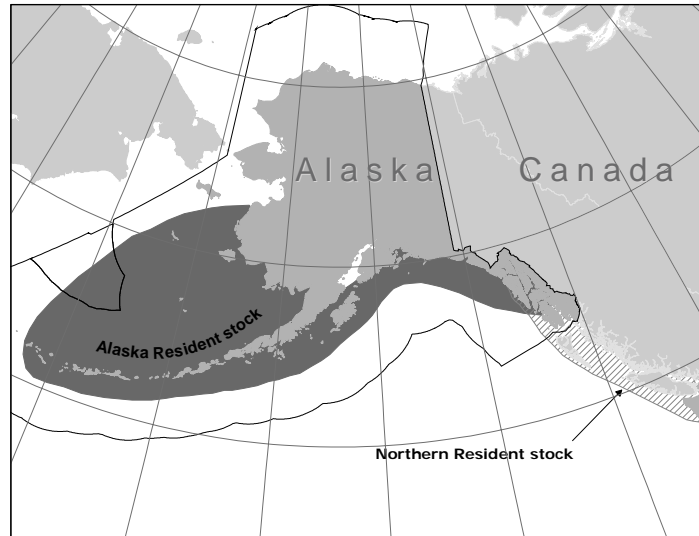
### **STOCK DEFINITION AND GEOGRAPHIC RANGE**

Killer whales have been observed in all oceans and seas of the world (Leatherwood and Dahlheim 1978). Although reported from tropical and offshore waters, killer whales occur at higher densities in colder and more productive waters of both hemispheres, with the greatest densities found at high latitudes (Mitchell 1975, Leatherwood and Dahlheim 1978, and Forney and Wade in press). Killer whales are found throughout the North Pacific. Along the west coast of North America, killer whales occur along the entire Alaskan coast (Braham and Dahlheim 1982), in British Columbia and Washington inland waterways (Bigg et al. 1990), and along the outer coasts of Washington, Oregon, and California (Green et al. 1992; Barlow 1995, 1997; Forney et al. 1995). Seasonal and year-round occurrence has been noted for killer whales throughout Alaska (Braham and Dahlheim 1982) and in the intracoastal waterways of British Columbia and Washington State, where pods have been labeled as 'resident,' 'transient,' and 'offshore' (Bigg et al. 1990, Ford et al. 2000) based on aspects of morphology, ecology, genetics, and behavior (Ford and Fisher 1982, Baird and Stacey 1988, Baird et al. 1992, Hoelzel et al. 1998, 2002, Barrett-Lennard 2000). Through examination of photographs of recognizable individuals and pods, movements of whales between geographical areas have been documented. For example, whales identified in Prince William Sound have been observed near Kodiak Island (Matkin et al. 1999) and whales identified in southeastern Alaska have been observed in Prince William Sound, British Columbia, and Puget Sound (Leatherwood et al. 1990, Dahlheim et al. 1997). Movements of killer whales between the waters of southeastern Alaska and central California have also been documented (Goley and Straley 1994).

Several studies provide evidence that the 'resident,' 'offshore,' and 'transient' ecotypes are genetically distinct in both mtDNA and nuclear DNA (Hoelzel and Dover 1991; Hoelzel et al. 1998, 2002; Barrett-Lennard 2000). Genetic differences have also been found between populations within the 'transient' and 'resident' ecotypes (Hoelzel et al. 1998, 2002; Barrett-Lennard 2000). Separate stock assessment reports have always acknowledged the distinction between resident, offshore, and transient killer whale populations.

Within the resident ecotype, association data was used to describe three separate populations in the North Pacific: Southern Residents, Northern Residents and Alaska Residents (Bigg et al. 1990; Ford et al. 1994, 2000; Matkin et al. 1999; Dahlheim et al. 1997). In previous stock assessment reports, the Alaska and northern resident populations were considered one stock. Acoustic data (Ford 1989, 1991; Yurk et al. 2002) and genetic data (Hoelzel et al. 1998, 2002; Barrett-Lennard 2000) have now confirmed that these three units represent discrete populations. The Southern Resident population is found in summer primarily in waters of Washington state and southern British Columbia and has never been seen to associate with other resident stocks. The Northern Resident population is found in summer primarily in central and northern British Columbia. Members of the Northern Resident population have been documented in southeastern Alaska; however, they have not been seen to intermix with Alaskan residents. Alaskan resident whales are found from southeastern Alaska to the Aleutian Islands and Bering Sea. Intermixing of Alaska residents have been documented among the three areas.

Based on data regarding association patterns, movements, acoustics, and genetic differences, eight killer whale stocks are now recognized within the Pacific U.S. EEZ: 1) the Alaska Resident stock - occurring from



**Figure 21.** Approximate distribution of killer whales in the eastern North Pacific (shaded area). The distribution of the eastern North Pacific Resident and Transient stocks are largely overlapping (see text).

southeastern Alaska to the Aleutian Islands and Bering Sea, 2) the Northern Resident stock - occurring from British Columbia through part of southeastern Alaska, 3) the Southern Resident stock - occurring mainly within the inland waters of Washington State and southern British Columbia, but also in coastal waters from British Columbia through California, 4) the Gulf of Alaska, Aleutian Islands, and Bering Sea Transient stock - occurring mainly from Prince William Sound through the Aleutian Islands and Bering Sea (see Fig. 21), 5) the AT1 transient stock - occurring in Alaska from Prince William Sound through the Kenai Fjords, 6) the West Coast transient stock - occurring from California through southeastern Alaska, 7) the Offshore stock - occurring from California through Alaska, and 8) the Hawaiian stock. 'Transient' whales in Canadian waters are considered part of the West Coast Transient stock. The Stock Assessment Reports for the Alaska Region contain information concerning all the killer whale stocks except the Hawaiian and Offshore stocks.

Movement data on Alaska resident stock members have been documented based on photographic matches. Southeastern Alaskan killer whale pods have been seen in Prince William Sound (Matkin et al. 1997) and in the Gulf of Alaska. Prince William Sound pods have been seen near Kodiak Island but never observed in southeastern Alaska (Matkin et al. 2003, Dahlheim et al. 1997). New information on movements of western Alaskan killer whales is being analyzed. However, recent studies have documented movements between the Bering Sea and Gulf of Alaska (NMML unpublished data).

## POPULATION SIZE

The Alaskan Resident stock includes killer whales from southeastern Alaska to the Aleutian Islands and Bering Sea. Preliminary analysis of photographic data resulted in the following minimum counts for 'resident' killer whales belonging to the Alaskan Resident stock (Note: individual whales have been matched between geographical regions and missing animals likely to be dead have been subtracted). In southeastern Alaska, 117 'resident' whales have been identified as of 2004 (NMML and North Gulf Oceanic Society unpublished data). In Prince William Sound and Kenai Fjords, another 501 resident whales have been identified as of 2004 (Matkin et al. 2003, Matkin, North Gulf Oceanic Society, pers. comm.). In the last stock assessment ~~assessment~~, a minimum count of 68 western Alaskan whales were added to the count because photo-identification data indicated that they associate with ~~with~~ Prince William Sound whales. Given that this information is now over 10 years old, we opted to deduct these 68 whales from the current counts.

Beginning in 2001, dedicated killer whale studies were initiated by NMML in Alaskan waters west of Kodiak Island, including the Aleutian Islands and Bering Sea. Between 2001 and 2003 (not all data from 2003 have been analyzed), using field assessments based on morphology, association data, and genetic analyses, additional resident whales have now been added to the Alaska resident stock. Internal matches within the NMML data set have been subtracted, resulting in a final count of western Alaskan residents for 2001 and 2003 as 464 whales. Studies conducted in western Alaska by the North Gulf Oceanic Society (NGOS) have resulted in the collection of photographs of approximately 600 resident killer whales; however, the NGOS and NMML data sets have not yet been matched so it is unknown how many of these 600 animals are included in the NMML collection. Another 41 whales were identified off Kodiak between 2000-2003 by the NGOS. These whales are added to the total of western Alaskan residents although they have not been matched to NMML photographs.

NMML conducted killer whale line-transect surveys for 3 years in July and August in 2001-2003. These surveys covered an area from approximately Resurrection Bay in the Kenai Fjords to the central Aleutians. The surveys covered an area from shore to 30-45 nautical miles offshore, with randomly located transects in a zig-zag pattern. A total of 9053 km of tracklines were surveyed between the Kenai Peninsula (~150°W) and Amchitka Pass (~179°W). A total of 41 on-effort sightings of killer whales were recorded, with an additional 16 sightings off-effort. Estimated abundance of resident killer whale from these surveys was 991 (CV = 0.52), with 95% confidence interval of 380-2585 (Zerbini et al. in prep.).

The line transect surveys provide an "instantaneous" (across ~40 days) estimate of the number of resident killer whales in the survey area. It should be noted that the photographic catalogue encompasses a larger area, including some data from areas such as Prince William Sound and the Bering Sea that were outside the line-transect survey area. Additionally, the number of whales in the photographic catalogue is a documentation of all whales seen in the area over the time period of the catalogue; movements of some individual whales have been documented between the line-transect survey area and locations outside the survey area. Accordingly, a larger number of resident killer whales may use the line-transect survey area at some point over the 3 years than would necessarily be found at one time in the survey area in July and August in a particular year.



Combining the counts of known ‘resident’ whales gives a minimum number of 1,123 (Southeast Alaska + Prince William Sound + Western Alaska; 117 + 501 + 505) killer whales belonging to the Alaska Resident stock (Table 18a29).

**Table 18a29.** Numbers of animals in each pod of killer whales belonging to the Alaska Resident stock of killer whales. A number followed by a “+” indicates a minimum count for that pod.

Pod ID	1999/00 estimate (and source)	2001/2004 estimate (and Source)
<b>Southeast Alaska</b>		
AF	49 (Dahlheim et al. 1997, Matkin et al. 1999)	61 (Matkin, North Gulf Oceanic Society, pers. comm.)
AG	27 (Dahlheim et al. 1997, Matkin et al. 1999)	33 (Matkin, North Gulf Oceanic Society, pers. comm.)
AZ	23+ (Dahlheim, AFSC-NMML, pers. comm.)	23+ (Dahlheim et al. 1997)
<b>Total, Southeast Alaska</b>	<b>99+</b>	<b>117+</b>
<b>Prince William Sound</b>		
	<b>Matkin et al. 1999</b>	<b>Matkin et al. 2003 and Matkin, North Gulf Oceanic Society, (pers. comm.)</b>
AA	---	8
AB	25	19
AB25	---	10
AD05	---	16
AD16	7	4
AE	16	19
AH01		9
AH20		12
AI	7	7
AJ	38	42
AK	12	13
AN10	20	27
AN20	assume 9	33
AS	assume 20	21
AS30		14
AW		24
AX01	21	20
AX27		24
AX32		15
AX40		14
AX48		20
AY	assume 11	18
Unassigned to pods	138 (C. Matkin, pers. comm)	112
<b>Total, Prince William Sound</b>	<b>341</b>	<b>501</b>
<b>Western Alaska</b>		
	<b>Dahlheim 1997 and NMML unpublished data</b>	<b>2001/2003 NMML unpublished data</b>
Unassigned to pods (NMML)	68+	464
Unassigned to pods (NGOS; Kodiak waters only)		41 (Matkin, North Gulf Oceanic Society, pers. comm.)
<b>Total, Western Alaska</b>	<b>68+</b>	<b>505</b>
<b>Total, all areas</b>	<b>507</b>	<b>1,123</b>



### Minimum Population Estimate

The survey technique utilized for obtaining the abundance estimate of killer whales is a direct count of individually identifiable animals. Thus the minimum population estimate ( $N_{\text{MIN}}$ ) for the Alaska Resident stock of killer whales is 1,123 animals. Other estimates of the overall population size (i.e.,  $N_{\text{BEST}}$ ) and associated  $\text{CV}(N)$  are not currently available. Given that researchers continue to identify new whales, the estimate of abundance based on the number of uniquely identified individuals known to be alive is likely conservative. However, the rate of discovering new resident whales within southeastern Alaska and Prince William Sound is relatively low (NMML unpublished data). Conversely, the rate of discovery of new whales in western Alaska was initially high (i.e., 2001 and 2002 field seasons). However, recent photographic data collected during 2003 and preliminary data from 2004 indicates that the rate of discovering new individual whales has decreased (NMML unpublished data).

Using the line-transect estimate of 991 ( $\text{CV} = 0.52$ ) results in an estimate of  $N_{\text{MIN}}$  (20th percentile) of 656. This is lower than the minimum number of individuals identified from photographs in recent years, so the photographic catalogue number is used for PBR calculations.

Some overlap of Northern Resident whales occur with the Alaskan Resident stock in southeastern Alaska. However, information on the percentage of time that the Northern Resident stock spends in Alaskan waters is unknown. However, as noted above, this minimum population estimate is considered conservative. This approach is consistent with the recommendations of the Alaska Scientific Review Group (DeMaster 1996).

### Current Population Trend

Recent data from Matkin et al. (2003) indicate that the component of the Alaska resident stock that summers in the Prince William Sound and Kenai Fjords area is increasing. With the exception of AB pod, which declined drastically after the *Exxon Valdez* oil spill and has not yet recovered, the component of the Alaska resident stock in the Prince William Sound and Kenai Fjords area has increased 3.3% per year from 1984-2002. Although the current minimum population count of 1,123 is higher than the last population count of 507, examination of only count data does not provide a direct indication of the net recruitment into the population. At present, reliable data on trends in population abundance for the entire Alaska resident stock of killer whales are unavailable.

### CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently unavailable for this stock of killer whales. Studies of 'resident' killer whale pods in the Pacific Northwest resulted in estimated population growth rates of 2.92% and 2.54% over the period from 1973 to 1987 (Olesiuk et al. 1990, Brault and Caswell 1993), and 3.3% over the period 1984-2002 (Matkin et al. 2003). Until additional data stock-specific data become available, it is recommended that the cetacean maximum theoretical net productivity rate ( $R_{\text{MAX}}$ ) of 4% be employed for this stock (Wade and Angliss 1997).

### POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 reauthorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor:  $\text{PBR} = N_{\text{MIN}} \times 0.5R_{\text{MAX}} \times F_R$ . The recovery factor ( $F_R$ ) for this stock is 0.5, the value for cetacean stocks with unknown population status (Wade and Angliss 1997). Thus, for the Eastern North Pacific Alaska Resident killer whale stock,  $\text{PBR} = 11.2$  animals ( $1,123 \times 0.02 \times 0.5$ ).

### ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

#### Fisheries Information

In previous assessments, there were six different commercial fisheries in Alaska that could have had incidental serious injuries or mortalities of killer whales and were observed. In 2004, the definitions of these commercial fisheries were changed to reflect target species; this new definition has resulted in the identification of 22 observed fisheries that use trawl, longline, or pot gear. Of these fisheries, there were four which incurred serious injuries or mortalities of killer whales between 1999-2004 (Table 48b30). The mean annual (total) mortality rate for all fisheries for 1999-03 was 2.5 ( $\text{CV} = 0.37$ ).

**Table 18b30.** Summary of incidental mortality of killer whales (Eastern North Pacific Northern Resident stock) due to commercial fisheries from 1999-2003 and calculation of the mean annual mortality rate.

Fishery name	Years	Data type	Range of observer coverage	Observed mortality (in given yrs.)	Estimated mortality (in given yrs.)	Mean annual mortality
Bering Sea/Aleutian Is. (BSAI) groundfish trawl	90-99	obs data	53-75%	0, 1, 1, 1, 0, 0, 0, 1, 0, 1	1, 2, 2, 1, 0, 0, 0, 2, 0, 1	0.6 (CV = 0.67)
BSAI groundfish longline (incl. misc. finfish and sablefish fisheries)		obs data	27-80%	0, 1, 0, 0, 0, 1, 0, 0, 0, 1	0, 1, 0, 0, 0, 1, 0, 0, 0, 3	0.8 (CV = 0.73)
BSAI flatfish trawl	1999 2000 2001 2002 2003	obs data	66.3 64.5 57.6 58.4 63.9	0 0 2 0 0	0 0 2 0 0	0.49 (CV = 0.55)
BSAI pollock trawl	1999 2000 2001 2002 2003	obs data	75.2 76.2 79.0 80.0 82.2	1 0 0 1 1	2 0 0 1 1	0.61 (CV = 0.22)
BSAI Greenland turbot longline	1999 2000 2001 2002 2003	obs data	30.8 52.8 33.5 37.3 40.9	1 0 0 0 0	3 0 0 0 0	0.60 (CV = 0.81)
BSAI Pacific cod longline	1999 2000 2001 2002 2003	obs data	31.8 35.2 29.5 29.6 29.8	0 0 0 0 1	0 0 0 0 4	0.84 (CV = 0.87)
Estimated total annual mortality						2.54 (CV = 0.37)

An additional source of information on the number of killer whales killed or injured incidental to commercial fishery operations is the self-reported fisheries information required of vessel operators by the MMPA. During the period between 1990 and 2003, fisher self-reports from all Alaska fisheries indicated only one killer whale mortality, which occurred in the Bering Sea groundfish trawl fishery in 1990. However, because logbook records (fisher self-reports required during 1990-94) are most likely negatively biased (Credle et al. 1994), these are considered to be minimum estimates. Self-reported fisheries data are incomplete for 1994, not available for 1995, and considered unreliable for 1996 to the present (see Appendix 7).

The estimated minimum mortality rate incidental to U. S. commercial fisheries recently monitored is 2.5 animals per year, based exclusively on observer data. As the animals which were taken incidental to commercial fisheries have not been identified genetically, it is not possible to determine whether they belonged to the Eastern North Pacific Northern Resident or the Eastern North Pacific Transient killer whale stock. Accordingly, these same mortalities can be found in the stock assessment report for the West Coast transient stock.

#### Subsistence/Native Harvest Information

There are no reports of a subsistence harvest of killer whales in Alaska.

#### Other Mortality

During the 1992 killer whale surveys conducted in the Bering Sea and western Gulf of Alaska, 9 of 182 (4.9%) individual whales in 7 of the 12 (58%) pods encountered had evidence of bullet wounds (Dahlheim and Waite 1993). The relationship between wounding due to shooting and survival is unknown. In Prince William Sound, the pod responsible for most of the fishery interactions has experienced a high level of mortality: between

1986 and 1991, 22 whales out of a pod of 37 (59%) are missing and considered dead (Matkin et al. 1994). The cause of death for these whales is unknown, but it may related to gunshot wounds or effects of the *Exxon Valdez* oil spill (Dahlheim and Matkin 1994). It is unknown what group or groups of individuals are responsible for shooting at killer whales.

#### **Other Issues**

Although only small numbers of killer whales are taken in the Bering Sea fisheries and there are no observed mortalities or serious injuries in the Gulf of Alaska, there are other interactions between the whales and the fisheries. Interactions between killer whales and longline vessels have been well documented (Dahlheim 1988, Yano and Dahlheim 1995). Data collected from the Japan/U. S. cooperative longline research surveys operating in the Bering Sea indicate that interactions may be increasing and expanding into the Aleutian Islands region (Yano and Dahlheim 1995). Sigler et al. (2002) reports that killer whale predation on sablefish catch has been fairly consistent since 1988, and has occurred mainly east of 170° W in the eastern Bering Sea, and to a lesser extent in the northeast Aleutians.

Recently, several fisheries observers reported that large groups of killer whales in the Bering Sea have followed vessels for days at a time, actively consuming the processing waste (Fishery Observer Program, unpubl. data, Alaska Fisheries Science Center, National Marine Fisheries Service).

#### **STATUS OF STOCK**

The eastern North Pacific Alaska resident stock of killer whale is not listed as “depleted” under the MMPA or listed as “threatened” or “endangered” under the Endangered Species Act. The minimum abundance estimate for the Alaska Resident stock is likely underestimated because researchers continue to encounter new whales in the Gulf of Alaska and western Alaskan waters. Because the population estimate is likely to be conservative, the PBR is also conservative.

Based on currently available data, the estimated annual fishery-related mortality level (2.5) exceeds 10% of the PBR, (1.1) and therefore cannot be considered to be insignificant and approaching zero mortality and serious injury rate. The estimated annual level of human-caused mortality and serious injury (2.5 animals per year) is not known to exceed the PBR (11.2). Therefore, the eastern North Pacific Alaska Resident stock of killer whales is not classified as a strategic stock. Population trends and status of this stock relative to its Optimum Sustainable Population size are currently unknown.

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## **KILLER WHALE (*Orcinus orca*): Eastern North Pacific Northern Resident Stock**

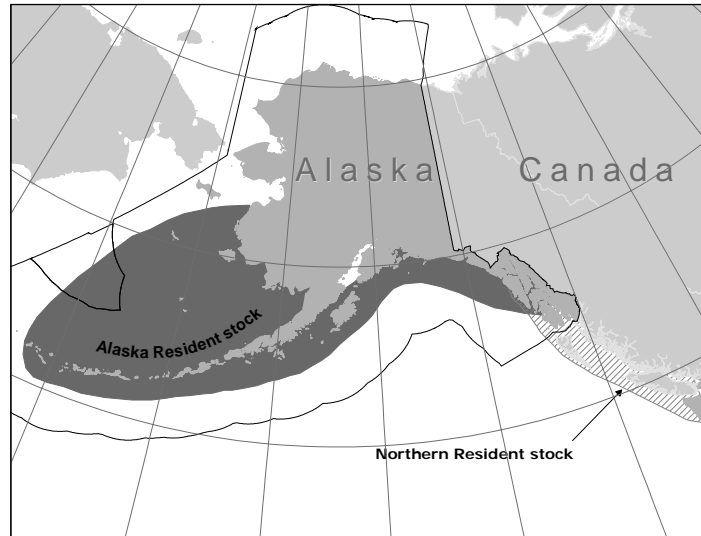
### **STOCK DEFINITION AND GEOGRAPHIC RANGE**

Killer whales have been observed in all oceans and seas of the world (Leatherwood and Dahlheim 1978). Although reported from tropical and offshore waters, killer whales occur at higher densities in colder and more productive waters of both hemispheres, with the greatest densities found at high latitudes (Mitchell 1975, Leatherwood and Dahlheim 1978, Forney and Wade in press). Killer whales are found throughout the North Pacific. Along the west coast of North America, killer whales occur along the entire Alaskan coast (Braham and Dahlheim 1982), in British Columbia and Washington inland waterways (Bigg et al. 1990), and along the outer coasts of Washington, Oregon, and California (Green et al. 1992; Barlow 1995, 1997; Forney et al. 1995). Seasonal and year-round occurrence has been noted for killer whales throughout Alaska (Braham and Dahlheim 1982) and in the intracoastal waterways of British Columbia and Washington State, where pods have been labeled as 'resident,' 'transient,' and 'offshore' (Bigg et al. 1990, Ford et al. 2000) based on aspects of morphology, ecology, genetics, and behavior (Ford and Fisher 1982; Baird and Stacey 1988; Baird et al. 1992; Hoelzel et al. 1998, 2002; Barrett-Lennard 2000). Through examination of photographs of recognizable individuals and pods, movements of whales between geographical areas have been documented. For example, whales identified in Prince William Sound have been observed near Kodiak Island (Matkin et al. 1999) and whales identified in Southeast Alaska have been observed in Prince William Sound, British Columbia, and Puget Sound (Leatherwood et al. 1990, Dahlheim et al. 1997). Movements of killer whales between the waters of Southeast Alaska and central California have also been documented (Goley and Straley 1994).

Several studies provide evidence that the 'resident,' 'offshore,' and 'transient' ecotypes are genetically distinct in both mtDNA and nuclear DNA (Hoelzel and Dover 1991; Hoelzel et al. 1998, 2002; Barrett-Lennard 2000). Genetic differences have also been found between populations within the 'transient' and 'resident' ecotypes (Hoelzel et al. 1998, 2002; Barrett-Lennard 2000).

Within the resident ecotype, association data was initially used to describe three separate communities in the North Pacific (Bigg et al. 1990; Ford et al. 1994, 2000; Matkin et al. 1999). The Southern Resident population is found in summer primarily in waters of Washington state and southern British Columbia. The Northern Resident population is found in summer primarily in central and northern British Columbia. Resident whales are found throughout Alaska. Acoustic data (Ford 1989, 1991; Yurk et al. 2002) and genetic data (Hoelzel et al. 1998, 2002; Barrett-Lennard 2000) have confirmed that these three units represent discrete populations. Separate stock assessment reports have always acknowledged the distinction between residents, offshore, and transient killer whale populations.

Based on data regarding association patterns, acoustics, movements, and genetic differences, eight killer whale stocks are now recognized within the Pacific U.S. EEZ: 1) the Alaska Resident stock - occurring from southeastern Alaska to the Aleutian Islands and Bering Sea, 2) the Northern Resident stock - occurring from British Columbia through part of southeastern Alaska, 3) the Southern Resident stock - occurring mainly within the inland waters of Washington State and southern British Columbia, but also in coastal waters from British Columbia through California, 4) the Gulf of Alaska, Aleutian Islands, and Bering Sea Transient stock - occurring mainly from



**Figure 2122.** Approximate distribution of killer whales in the eastern North Pacific (shaded area). The distribution of the eastern North Pacific Resident and Transient stocks are largely overlapping (see text).



Prince William Sound through the Aleutian Islands and Bering Sea (see Fig. 24-22), 5) the AT1 transient stock - occurring in Alaska from Prince William Sound through the Kenai Fjords, 6) the West Coast transient stock - occurring from California through southeastern Alaska, 7) the Offshore stock - occurring from California through Alaska, and 8) the Hawaiian stock. 'Transient' whales in Canadian waters are considered part of the West Coast Transient stock. The Stock Assessment Reports for the Alaska Region contain information concerning all the killer whale stocks except the Hawaiian and Offshore stocks.

The known range of the Northern Resident stock includes Canadian waters from approximately mid-Vancouver Island and throughout most of southeastern Alaskan waters (Ford et al. 2000, Dahlheim unpublished data). They have been seen infrequently in Washington state waters.

## POPULATION SIZE

The Eastern North Pacific Northern Resident stock is a transboundary stock, and includes killer whales that frequent British Columbia, Canada and southeastern Alaska. Photo-identification studies since 1970 (Ford et al. 2000) have catalogued every individual in this population resulting in the following minimum count for 'resident' killer whales belonging to the Eastern North Pacific Northern Resident stock (Note: individual whales have been matched between geographical regions and missing animals likely to be dead have been subtracted). A count of 216 'resident' whales was made as of 1998 (Ford et al. 2000; Table 18a-31). Births and deaths since 1998 are not accounted for here.

**Table 18a-31.** Numbers of animals in each pod of killer whales belonging to the Eastern North Pacific Northern Resident stock of killer whales.

<b>British Columbia</b>	<b>Ford et al. 1994</b>	<b>Ford et al. 2000</b>
A1	15	16
A4	11	11
A5	12	13
B1	9	7
C1	13	14
D1	7	12
H1	8	9
I1	10	8
I2	7	2
I18	19	16
G1	28	29
G12	11	13
I11	18	22
I31	10	12
R1	23	29
W1	3	3
<b>Total</b>	<b>204</b>	<b>216</b>

## Minimum Population Estimate

The survey technique utilized for obtaining the abundance estimate of killer whales is a direct count of individually identifiable animals. Other estimates of the overall population size (i.e.,  $N_{BEST}$ ) and associated CV(N) are not currently available. Because this population has been studied for such a long time period, each individual is well documented and, except for births, no new individuals are expected to be discovered. Therefore, the estimated population size of 216 animals can also serve as a minimum count of the population.

Thus, the minimum population estimate ( $N_{MIN}$ ) for the ~~Eastern North Pacific~~ Northern Resident stock of killer whales is 216 animals, which includes animals found in Canadian waters (see PBR Guidelines regarding the status of migratory transboundary stocks, Wade and Angliss 1997). Information on the percentage of time animals typically encountered in Canadian waters spend in U. S. waters is unknown. This approach is consistent with the recommendations of the Alaska Scientific Review Group (DeMaster 1996).

### **Current Population Trend**

Studies of 'resident' killer whale pods in the Pacific Northwest resulted in estimated population growth rates of 2.92% and 2.54% over the period from 1973 to 1987 (Olesiuk et al. 1990, Brault and Caswell 1993). These rates were for combined northern and southern resident communities. Recent analyses indicate that some pods in the Northern Resident population had increased at approximately 3% per year and were apparently approaching carrying capacity since the rates of increase appeared to be slowing (P. Olesiuk as reported in Dahlheim et al. 2000).

### **CURRENT AND MAXIMUM NET PRODUCTIVITY RATES**

A reliable estimate of the maximum net productivity rate is currently unavailable for this stock of killer whales. Studies of 'resident' killer whale pods in British Columbia and Washington waters resulted in estimated population growth rates of 2.92% and 2.54% over the period from 1973 to 1987 (Olesiuk et al. 1990, Brault and Caswell 1993). Until more recent stock-specific data become available, it is recommended that the cetacean maximum theoretical net productivity rate ( $R_{MAX}$ ) of 4% be employed for this stock (Wade and Angliss 1997).

### **POTENTIAL BIOLOGICAL REMOVAL**

Under the 1994 reauthorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor:  $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$ . The recovery factor ( $F_R$ ) for this stock is 0.5, the value for cetacean stocks with unknown population status (Wade and Angliss 1997). Thus, for the Eastern North Pacific Northern Resident killer whale stock,  $PBR = 2.16$  animals ( $216 \times 0.02 \times 0.5$ ).

### **ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY**

#### **Fisheries Information**

Due to limited Canadian observer program coverage, there are few data on the mortality of marine mammals incidental to Canadian commercial fisheries (i.e., those similar to U.S. fisheries known to interact with killer whales). The sablefish longline fishery accounts for a large proportion of the commercial fishing/killer whale interactions in Alaska waters. Such interactions have not been reported in Canadian waters where sablefish are taken via a pot fishery. Since 1990, there have been no reported fishery-related strandings of killer whales in Canadian waters. However, in 1994, one killer whale was reported to have contacted a salmon gillnet but did not entangle (Guenther et al. 1995). Data regarding the level of killer whale mortality related to commercial fisheries in Canadian waters, though thought to be small, are not readily available or reliable which results in an underestimate of the annual mortality for this stock.

#### **Subsistence/Native Harvest Information**

There are no reports of a subsistence harvest of killer whales in Alaska or Canada.

#### **Other Mortality**

The shooting of killer whales in Canadian waters has been a concern in the past. However, in recent years the Canadian portion of the stock has been researched so extensively that evidence of bullet wounds would have been noticed if shooting was prevalent (G. Ellis, pers. comm., Pacific Biological Station, Canada).

#### **Other Issues**

In U.S. waters, there is considerable interaction between killer whales ~~whales~~ and fisheries aside from incidental take. Interactions between killer whales and longline vessels, specifically predation by killer whales on sablefish catch, have been well documented (Dahlheim 1988, Yano and Dahlheim 1995, Sigler et al. 2002). However, it is unknown whether these interactions also occur in Canada.

### **STATUS OF STOCK**

The northern resident killer whale stock is not listed as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. In April 1999, the Committee on the Status of Endangered Wildlife in Canada voted to designate all resident killer whales in British Columbia as "threatened", and the designation appears to have been based on the fact that the small size and low growth rate make the northern resident populations at risk from immunotoxic effects of persistent toxic chemicals and a reduction in prey

availability (Baird, 1999). Baird (1999) also indicates that the commercial and recreational whale watching industry may be having an impact. It is likely that the human-caused mortality level for this stock is underestimated. The human-caused mortality has been underestimated due primarily to a lack of information on Canadian fisheries; however, a review of the status of killer whales in Canada indicates that the available evidence suggests that mortality incidental to commercial fisheries is rare and does not have the potential to cause substantial population reductions in the future (Baird, 1999).

Based on currently available data, the estimated annual fishery related mortality level is zero, which does not exceed 10% of the PBR (0.22) and therefore is considered to be insignificant and approaching zero mortality and serious injury rate. The estimated annual level of human-caused mortality and serious injury is not known to exceed the PBR (2.2). Therefore, the eastern North Pacific northern resident stock of killer whales is not classified as a strategic stock. Population trends and status of this stock relative to its Optimum Sustainable Population size are currently unknown.

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**KILLER WHALE (*Orcinus orca*):**  
**Gulf of Alaska, Aleutian Islands, and Bering Sea Transient stock**

**STOCK DEFINITION AND GEOGRAPHIC RANGE**

Killer whales have been observed in all oceans and seas of the world (Leatherwood and Dahlheim 1978). Although reported from tropical and offshore waters, killer whales occur at higher densities in colder and more productive waters of both hemispheres, with the greatest densities found at high latitudes (Mitchell 1975, Leatherwood and Dahlheim, 1978, and Forney and Wade in press). Killer whales are found throughout the North Pacific. Along the west coast of North America, killer whales occur along the entire Alaskan coast (Braham and Dahlheim 1982), in British Columbia and Washington inland waterways (Bigg et al. 1990), and along the outer coasts of Washington, Oregon, and California (Green et al. 1992; Barlow 1995, 1997; Forney et al. 1995). Seasonal and year-round occurrence has been noted for killer whales throughout Alaska (Braham and Dahlheim 1982) and in the intracoastal waterways of British Columbia and Washington State, where pods have been labeled as 'resident,' 'transient,' and 'offshore' (Bigg et al. 1990, Ford et al. 2000) based on aspects of morphology, ecology, genetics, and behavior (Ford and Fisher 1982, Baird and Stacey 1988, Baird et al. 1992, Hoelzel et al. 1998, 2002, Barrett-Lennard 2000). Through examination of photographs of recognizable individuals and pods, movements of whales between geographical areas have been documented. For example, whales identified in Prince William Sound have been observed near Kodiak Island (Matkin et al. 1999) and whales identified in Southeast Alaska have been observed in Prince William Sound, British Columbia, and Puget Sound (Leatherwood et al. 1990, Dahlheim et al. 1997). Movements of killer whales between the waters of Southeast Alaska and central California have also been documented (Goley and Straley 1994).

Several studies provide evidence that the 'resident', 'offshore', and 'transient' ecotypes are genetically distinct in both mtDNA and nuclear DNA (Hoelzel and Dover 1991; Hoelzel et al. 1998, 2002; Barrett-Lennard 2000). Genetic differences have also been found between populations within the 'transient' and 'resident' ecotypes (Hoelzel et al. 1998, 2002; Barrett-Lennard 2000).

Until recently, transient killer whales of Alaska had only been studied intensively in southeastern Alaska and in the Gulf of Alaska (from Prince William Sound, through the Kenai Fjords, and around Kodiak Island). In the Gulf of Alaska, Matkin et al. (1999) described two communities of transients which were never found in association with one another, the so-called 'Gulf of Alaska' transients and 'AT1' transients. Neither of these communities associates with transient killer whales that range from California to southeastern Alaska, which has been termed the 'west coast' community. 'Gulf of Alaska' transients are seen throughout the Gulf of Alaska, including occasional sightings in Prince William Sound. AT1 transients are primarily seen in Prince William Sound and in the Kenai Fjords region, and are therefore partially sympatric with 'Gulf of Alaska' transients. Transients that associate with the 'Gulf of Alaska' community have been found to have two mtDNA haplotypes, neither of which is found in the west coast or AT1 communities. Members of the AT1 community share a single mtDNA haplotype. Transient killer whales from the 'west coast' community have been found to share a single mtDNA haplotype that is not found in the other communities. Additionally, all three communities have been found to have significant differences in nuclear (microsatellite) DNA (Barrett-Lennard 2000). Acoustic differences have been found, as well, as Saulitis (1993) described acoustic differences between 'Gulf of Alaska' transients and AT1 transients. For these reasons, the



**Figure 24.23.** Approximate distribution of killer whales in the eastern North Pacific (shaded area). The distribution of the eastern North Pacific Resident and Transient stocks are largely overlapping (see text).

'Gulf of Alaska' transients are considered part of a population that is discrete from the AT1 population, and both of these communities are considered discrete from the 'west coast' transients.

Recent research in western Alaska, particularly along the south side of the Alaska Peninsula and in the eastern Aleutian Islands, have identified transient killer whales that share acoustic calls and mtDNA haplotypes with the Gulf of Alaska transients (NMML unpublished, North Gulf Oceanic Society unpublished), suggesting transient whales there may be part of the same population as Gulf of Alaska transients. However, samples from the central Aleutian Islands and Bering Sea have identified mtDNA haplotypes not found in Gulf of Alaska transients, suggesting the possibility there is some population structure in western Alaska. At this time, there is insufficient data to further resolve transient population structure in western Alaska. Therefore, transient-type killer whales from the Aleutian Islands and Bering Sea are considered to be part of a single population that includes 'Gulf of Alaska' transients. Killer whales are also seen in the northern Bering Sea and Beaufort Sea, but little is known about these whales and they are assumed to be part of this stock if they are transient-type whales.

In summary, within the transient ecotype, association data (Ford et al. 1994, Ford and Ellis 1999, Matkin et al. 1999), acoustic data (Saulitis 1993, Ford and Ellis 1999) and genetic data (Hoelzel et al. 1998, 2002; Barrett-Lennard 2000) confirms that three communities of transient whales exist and represent three discrete populations: 1) Gulf of Alaska, Aleutian Islands, and Bering Sea transients, 2) AT1 transients, and 3) West Coast transients.

Based on data regarding association patterns, movements, acoustics, and genetic differences, eight killer whale stocks are now recognized within the Pacific U.S. EEZ: 1) the Alaska Resident stock - occurring from southeastern Alaska to the Aleutian Islands and Bering Sea, 2) the Northern Resident stock - occurring from British Columbia through part of southeastern Alaska, 3) the Southern Resident stock - occurring mainly within the inland waters of Washington State and southern British Columbia, but also in coastal waters from British Columbia through California, 4) the Gulf of Alaska, Aleutian Islands, and Bering Sea Transient stock - occurring mainly from Prince William Sound through the Aleutian Islands and Bering Sea (see Fig. 21<sup>23</sup>), 5) the AT1 transient stock - occurring in Alaska from Prince William Sound through the Kenai Fjords, 6) the West Coast transient stock - occurring from California through southeastern Alaska, 7) the Offshore stock - occurring from California through Alaska, and 8) the Hawaiian stock. 'Transient' whales in Canadian waters are considered part of the West Coast Transient stock. The Stock Assessment Reports for the Alaska Region contain information concerning all the killer whale stocks except the Hawaiian and Offshore stocks.

In recent years, a small number of the 'Gulf of Alaska' transients have been seen in southeastern Alaska; previously only 'west coast' transients had been seen in southeastern Alaska. Therefore, the Gulf of Alaska, Aleutian Islands, and Bering Sea Transient stocks occupy a range that includes all of the U.S. EEZ in Alaska, though few individuals from this population have been seen in southeastern Alaska.

## POPULATION SIZE

In January 2004 the North Gulf Oceanic Society (NGOS) and the National Marine Mammal Laboratory (NMML) held a joint workshop to match identification photographs of transient killer whales from this population. That analysis of photographic data resulted in the following minimum counts for 'transient' killer whales belonging to the Gulf of Alaska, Aleutian Islands, and Bering Sea Transient stock. In the Gulf of Alaska (east of the Shumagin Islands), 60 whales were identified by NGOs, including whales from Matkin et al. (1999) as well as whales identified in subsequent years (but not including whales identified as part of the AT1 population). NMML identified 43 whales and 10 matches were found between the NGOs and NMML catalogues. Therefore, a total of 93 transients (60+43-10) have been identified in the Gulf of Alaska. In the Aleutian Islands (west of and including the Shumagin Islands) and Bering Sea, using data from 2001-03, NGOs identified a total of 123 transient killer whales. Over the same time period, NMML identified 124 transient killer whales. Twenty-six matches were found between these two catalogues, leaving a total of 221 transient whales (123+124-26) identified in the Aleutian Islands and Bering Sea (not counting 3 whales previously identified in the eastern area). Combining the counts of cataloged 'transient' whales gives a minimum number of 314 (93 + 221) transient killer whales belonging to the Gulf of Alaska, Aleutian Islands, and Bering Sea Transient stock.

NMML conducted killer whale line-transect surveys for 3 years in July and August in 2001-2003. These surveys covered an area from approximately Resurrection Bay in the Kenai Fjords to the central Aleutians. The surveys covered an area from shore to 30-45 nautical miles offshore, with randomly located transects in a zig-zag pattern. Estimated transient killer whale abundance from these surveys, using post-encounter estimates of group size, was 249 (CV = 0.50), with 95% confidence interval of 99-628 (Zerbini et al in prep.).

The line transect surveys provide an "instantaneous" (across ~40 days) estimate of the number of transient killer whales in the survey area. It should be noted that the photographic catalogue encompasses a larger area,



including some data from areas such as Prince William Sound and the Bering Sea that were outside the line-transect survey area. Additionally, the number of whales in the photographic catalogue is a documentation of all whales seen in the area over the time period of the catalogue; movements of some individual whales have been documented between the line-transect survey area and locations outside the survey area. Accordingly, a larger number of transient killer whales may use the line-transect survey area at some point over the three years than would necessarily be found at one time in the survey area in July and August in a particular year.

### **Minimum Population Estimate**

The 20<sup>th</sup> percentile of the line transect survey estimate is 167. The photograph catalogue estimate of transient killer whales is a direct count of individually identifiable animals. However, the number of cataloged whales does not necessarily represent the number of live animals. Some animals may have died, but whales can not be presumed dead if not resighted because long periods of time between sightings is common for some 'transient' animals. The catalogue for the western area used data only from 2001-03, decreasing the potential bias from using whales that may have died prior to the end of the time period. However, given that researchers continue to identify new whales, the estimate of abundance based on the number of uniquely identified individuals cataloged is likely conservative.

Thus, the minimum population estimate ( $N_{\text{MIN}}$ ) for the Gulf of Alaska, Aleutian Islands, and Bering Sea transient stock of killer whales is 314 animals based on the count of individuals using photo-identification.

### **Current Population Trend**

At present, reliable data on trends in population abundance for the Gulf of Alaska, Aleutian Islands, and Bering Sea Transient stock of killer whales are unavailable.

### **CURRENT AND MAXIMUM NET PRODUCTIVITY RATES**

A reliable estimate of the maximum net productivity rate is currently unavailable for this stock of killer whales. Studies of 'resident' killer whale pods in the Pacific Northwest resulted in estimated population growth rates of 2.92% and 2.54% over the period from 1973 to 1987 (Olesiuk et al. 1990, Brault and Caswell 1993). Until stock-specific data become available, it is recommended that the cetacean maximum theoretical net productivity rate ( $R_{\text{MAX}}$ ) of 4% be employed for this stock (Wade and Angliss 1997).

### **POTENTIAL BIOLOGICAL REMOVAL**

Under the 1994 reauthorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor:  $PBR = N_{\text{min}} \times 0.5R_{\text{Max}} \times F_R$ . The recovery factor ( $F_R$ ) for this stock is 0.5, the value for cetacean stocks with unknown population status with a mortality rate  $CV \geq 0.80$  (Wade and Angliss 1997). Thus, for the Eastern North Pacific Transient killer whale stock,  $PBR = 3.1$  animals ( $314 \times 0.02 \times 0.5$ ). The proportion of time that this trans-boundary stock spends in Canadian waters cannot be determined (G. Ellis, Pacific Biological Station, Canada, pers. comm.)

### **HUMAN-CAUSED MORTALITY AND SERIOUS INJURY**

#### **Fisheries Information**

In previous assessments, there were six different federal commercial fisheries in Alaska that could have had incidental serious injuries or mortalities of killer whales and were observed. In 2004, the definitions of these fisheries were changed to reflect target species; these new definitions have resulted in the identification of 22 observed fisheries that use trawl, longline, or pot gear. Of these fisheries, there were four which incurred serious injury and mortality of killer whales between 1999-2003 (Table xx32).

The mean annual mortality and serious injury level was 0.5 ( $CV = 0.55$ ) for the Bering Sea/Aleutian Islands flatfish trawl fishery, 0.6 ( $CV = 0.22$ ) for the Bering Sea/Aleutian Islands pollock trawl fishery, 0.6 ( $CV = 0.81$ ) for the Bering Sea/Aleutian Islands turbot longline fishery, and 0.8 ( $CV = 0.87$ ) for the Bering Sea/Aleutian Islands Pacific cod longline fishery, resulting in a mean annual mortality rate of 2.54 killer whales per year from observed fisheries.

An additional source of information on the number of killer whales killed or injured incidental to commercial fishery operations is the self-reported fisheries information required of vessel operators by the MMPA. During the period between 1994 and 1998, there were no fisher self-reports of killer whale mortalities from any

Alaska fisheries operating within the range of this stock. However, because logbook records (fisher self-reports required during 1990-94) are most likely negatively biased (Credle et al. 1994), these are considered to be minimum estimates. Self-reported fisheries data are incomplete for 1994, not available for 1995, and considered unreliable after 1995 (see Appendix 7 for details.)

The estimated minimum mortality rate incidental to recently monitored U.S. commercial fisheries is 2.5. As the animals which were taken incidental to commercial fisheries in Alaska have not been identified genetically, it is not possible to determine whether they belonged to a "resident" or "transient" stock. Accordingly, these same mortalities can be found in the stock assessment report for the Northern Resident stock.

**Table 1932.** Summary of incidental mortality of killer whales (Eastern North Pacific Transient stock) due to commercial fisheries and calculation of the mean annual mortality rate. Mean annual takes are based on 1994-98 data unless noted otherwise.

Fishery name	Years	Data type	Percent observer coverage	Observed mortality	Estimated mortality	Mean annual takes (CV in parentheses)
<del>Bering Sea/Aleutian Is. (BSAI) groundfish trawl</del>	94-98	obs data	64.67% 67.3% 66.2% 63.9% 67.0%	0, 0, 0, 1, 0	0, 0, 0, 2, 0	0.4 (1.0)
BSAI groundfish longline (incl. misc. finfish and sablefish fisheries)	94-98  95	obs data  unmonitored haul	27.36%	0, 0, 0, 0, 0  1	0, 0, 0, 0, 0	0  0.2
<del>CA/OR thresher shark/swordfish drift gillnet</del>	94-98	obs data	12.23%	0, 1, 0, 0, 0	0, 6, 0, 0, 0	0*
BSAI flatfish trawl	1999 2000 2001 2002 2003	obs data	66.3 64.5 57.6 58.4 63.9	0 0 2 0 0	0 0 2 0 0	0.49 (CV = 0.55)
BSAI pollock trawl	1999 2000 2001 2002 2003	obs data	75.2 76.2 79.0 80.0 82.2	1 0 0 1 1	1 0 0 1 1	0.61 (CV = 0.22)
BSAI turbot longline	1999 2000 2001 2002 2003	obs data	30.8 52.8 33.5 37.3 40.9	1 0 0 0 0	3 0 0 0 0	0.60 (CV = 0.81)
BSAI Pacific cod longline	1999 2000 2001 2002 2003	obs data	31.8 35.2 29.5 29.6 29.8	0 0 0 0 1	0 0 0 0 4	0.84 (CV = 0.87)
Estimated total annual takes						0.6 (1.0) 2.54 (CV = 0.37)

### Subsistence/Native Harvest Information

There are no reports of a subsistence harvest of killer whales in Alaska or Canada.

### Other Mortality

There is considerable interaction between killer whales and longline vessels in the Bering Sea (Dahlheim 1988; Yano and Dahlheim 1995; Perez 2003; M. Perez, unpubl. data; Sigler et al. 2003) and in the Gulf of Alaska (Sigler et al. 2003), as well as reports of killer whales consuming the processing waste of Bering Sea groundfish trawl fishing vessels (M. Perez, unpubl. data). However, it most likely is the 'resident' stock of killer whales that is involved in such fishery interactions since these whales are known to be fish eaters, while 'transient' whales have only been observed feeding on marine mammals.

Collisions with boats are another source of mortality. One mortality due to a ship strike occurred in 1998, when a killer whale struck the propeller of a vessel in the Bering Sea groundfish trawl fishery, ~~resulting in an estimated annual mortality of 0.2 killer whales from this stock in 1994-98.~~

### STATUS OF STOCK

The Gulf of Alaska, Aleutian Islands, and Bering Sea transient stock of killer whales is not designated as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. Based on currently available data, the estimated annual fishery-related mortality level (2.5) exceeds 10% of the PBR (0.3) and, therefore, cannot be considered to be insignificant and approaching zero mortality and serious injury rate. The estimated annual level of human-caused mortality and serious injury (2.5 animals per year) is less than the PBR (3.1). **Therefore, the Gulf of Alaska, Aleutian Islands, and Bering Sea transient stock of killer whales is not classified as a strategic stock.** Population trends and status of this stock relative to its Optimum Sustainable Population (OSP) level are currently unknown.

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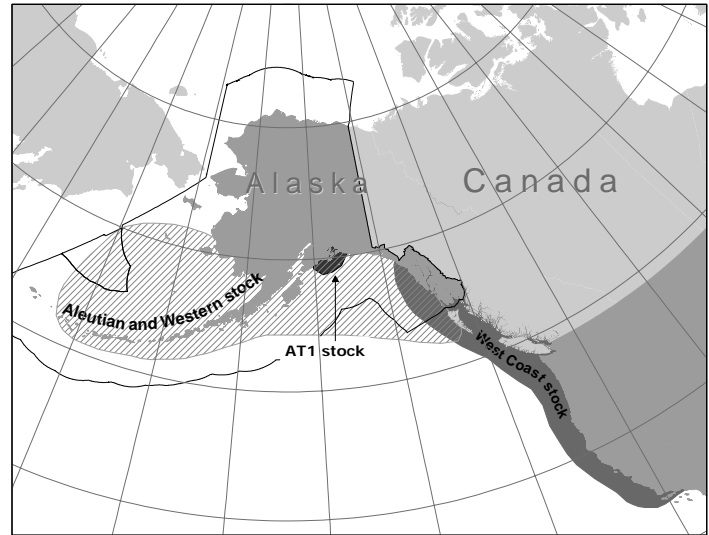
**KILLER WHALE (*Orcinus orca*):  
AT1 transient stock**

**STOCK DEFINITION AND GEOGRAPHIC RANGE**

Killer whales have been observed in all oceans and seas of the world (Leatherwood and Dahlheim 1978). Although reported from tropical and offshore waters, killer whales occur at higher densities in colder and more productive waters of both hemispheres, with the greatest densities found at high latitudes (Mitchell 1975, Leatherwood and Dahlheim, 1978, and Forney and Wade in press). Killer whales are found throughout the North Pacific. Along the west coast of North America, killer whales occur along the entire Alaskan coast (Braham and Dahlheim 1982), in British Columbia and Washington inland waterways (Bigg et al. 1990), and along the outer coasts of Washington, Oregon, and California (Green et al. 1992; Barlow 1995, 1997; Forney et al. 1995). Seasonal and year-round occurrence has been noted for killer whales throughout Alaska (Braham and Dahlheim 1982) and in the intracoastal waterways of British Columbia and Washington State, where pods have been labeled as 'resident,' 'transient,' and 'offshore' (Bigg et al. 1990, Ford et al. 2000) based on aspects of morphology, ecology, genetics, and behavior (Ford and Fisher 1982; Baird and Stacey 1988; Baird et al. 1992; Hoelzel et al. 1998, 2002; Barrett-Lennard 2000). Through examination of photographs of recognizable individuals and pods, movements of whales between geographical areas have been documented. For example, whales identified in Prince William Sound have been observed near Kodiak Island (Matkin et al. 1999) and whales identified in Southeast Alaska have been observed in Prince William Sound, British Columbia, and Puget Sound (Leatherwood et al. 1990, Dahlheim et al. 1997). Movements of killer whales between the waters of Southeast Alaska and central California have also been documented (Goley and Straley 1994).

Several studies provide evidence that the 'resident', 'offshore', and 'transient' ecotypes are genetically distinct in both mtDNA and nuclear DNA (Hoelzel and Dover 1991; Hoelzel et al. 1998, 2002; Barrett-Lennard 2000). Genetic differences have also been found between populations within the 'transient' and 'resident' ecotypes (Hoelzel et al. 1998, 2002; Barrett-Lennard 2000).

Until recently, transient killer whales in Alaska had only been studied intensively in southeastern Alaska and in the Gulf of Alaska (from Prince William Sound, through the Kenai Fjords, and around Kodiak Island). In the Gulf of Alaska, Matkin et al. (1999) described two communities of transients which were never found in association with one another, the so-called 'Gulf of Alaska' transients and 'AT1' transients. Neither of these communities associates with transient killer whales that range from California to southeastern Alaska, which has been termed the 'west coast' community. 'Gulf of Alaska' transients are seen throughout the Gulf of Alaska, including occasional sightings in Prince William Sound. AT1 transients are primarily seen in Prince William Sound and in the Kenai Fjords region, and are therefore partially sympatric with 'Gulf of Alaska' transients. Transients that associate with the 'Gulf of Alaska' community have been found to have two mtDNA haplotypes, neither of which is found in the west coast or AT1 communities. Members of the AT1 community share a single mtDNA haplotype. Transient killer whales from the 'west coast' community have been found to share a single mtDNA haplotype that is not found in the other communities. Additionally, all three communities have been found to have significant differences in nuclear (microsatellite) DNA (Barrett-Lennard 2000). Acoustic differences have been found, as well, as Saulitis (1993) described acoustic differences between 'Gulf of Alaska' transients and AT1 transients. For these reasons, the



**Figure 2124.** Approximate distribution of killer whales in the eastern North Pacific (shaded area). The distribution of the eastern North Pacific Resident and Transient stocks are largely overlapping (see text).



'Gulf of Alaska' transients are considered part of a population that is discrete from the AT1 population, and both of these communities are considered discrete from the 'west coast' transients.

Recent research in western Alaska, particularly along the south side of the Alaska Peninsula and in the eastern Aleutian Islands, have identified transient killer whales that share acoustic calls and mtDNA haplotypes with the Gulf of Alaska transients (NMML unpublished, NGOS unpublished), suggesting transient whales there may be part of the same population as Gulf of Alaska transients. On the other hand, samples from the central Aleutian Islands and Bering Sea have identified mtDNA haplotypes not found in Gulf of Alaska transients, suggesting the possibility there is some population structure in western Alaska. At this point, there is insufficient data to resolve transient population structure in western Alaska any further. Therefore, transient-type killer whales from the Aleutian Islands and Bering Sea are considered to be part of a single population that includes 'Gulf of Alaska' transients. Killer whales are seen in the northern Bering Sea and Beaufort Sea, but little is known about these whales.

In summary, within the transient ecotype, association data (Ford et al. 1994, Ford and Ellis 1999, Matkin et al. 1999), acoustic data (Saulitis 1993, Ford and Ellis 1999) and genetic data (Hoelzel et al. 1998, 2002, Barrett-Lennard 2000) confirms that three communities of transient whales exist and represent three discrete populations: 1) Gulf of Alaska, Aleutian Islands, and Bering Sea transients, 2) AT1 transients, and 3) West Coast transients.

Based on data regarding association patterns, movements, acoustics, genetic differences and potential fishery interactions, eight killer whale stocks are recognized within the Pacific U.S. EEZ: 1) the Alaska Resident stock - occurring from southeastern Alaska to the Aleutian Islands and Bering Sea, 2) the Northern Resident stock - occurring from British Columbia through part of southeastern Alaska, 3) the Southern Resident stock - occurring mainly within the inland waters of Washington State and southern British Columbia, but also in coastal waters from British Columbia through California, 4) the Gulf of Alaska, Aleutian Islands, and Bering Sea Transient stock - occurring mainly from Prince William Sound through the Aleutian Islands and Bering Sea (see Fig. 2424), 5) the AT1 transient stock - occurring in Alaska from Prince William Sound through the Kenai Fjords, 6) the West Coast transient stock - occurring from California through southeastern Alaska, 7) the Offshore stock - occurring from California through Alaska, and 8) the Hawaiian stock. 'Transient' whales in Canadian waters are considered part of the West Coast Transient stock. The Stock Assessment Reports for the Alaska Region contain information concerning all the killer whale stocks except the Hawaiian and off shore stocks.

AT1 killer whales were first identified as a separate, cohesive group in 1984, when 22 transient-type whales were documented in Prince William Sound (Leatherwood et al. 1984, Heise et al. 1991), though individual whales from the group had been photographed as early as 1978. Once the North Gulf Oceanic Society began consistent annual research effort in Prince William Sound, AT1 killer whales were re-sighted frequently. In fact, AT1 killer whales were found to be some of the most frequently sighted killer whales in Prince William Sound (Matkin et al. 1993, 1994). Gulf of Alaska transients are seen less frequently in Prince William Sound, with periods of several years between resightings not uncommon.

AT1 killer whales have never been seen in association with sympatric resident killer whale pods or with Gulf of Alaska transients (Matkin et al. 1999b). As discussed above, the AT1 group were found to be acoustically and genetically different from other transient killer whales in the North Pacific (Saulitis 1993, Barrett-Lennard 2000). AT1 killer transients are considered a population that is discrete from 'Gulf of Alaska' transients, which are part of the Gulf of Alaska, Aleutian Islands, and Bering Sea Transient stock.

The AT1 transients appear to have a more limited geographic range than do other transients. Though seen mostly in Prince William Sound, some AT1s were photographed between Prince William Sound and Resurrection Bay in 1992 (K. Heise, Vancouver Aquarium, pers. comm. in Matkin and Saulitis 1994). It is now known that they can be seen in Prince William Sound and Resurrection and Aialik Bays of the Kenai Fjords year-round (Saulitis et al. 2000). However, they are not known to travel east of Prince William Sound or west of Kenai Fjords, Alaska, an apparent range of at least 200 miles (Matkin et al. 1999b).

## POPULATION SIZE

Using photographic identification methods, all 22 individuals in the population were completely censused for the first time in 1984 (Leatherwood et al. 1984a). All 22 AT1s were seen annually or biannually from 1984 to 1988 (Matkin et al. 1999a). The *Exxon Valdez* oil spill occurred in spring of 1989. Nine individuals from the AT1 group have been missing since 1990 (last seen in 1989), and 2 have been missing since 1992 (last seen in 1990 and 1991). All 11 are presumed dead (Matkin et al. 2000). Three of the AT1s that presumably died (AT5, AT7, and AT8) were seen near the *Exxon Valdez* (with AT6) shortly after the spill (Matkin et al. 1993, 1994). One of the 11 was confirmed dead – AT19 was found dead on a beach in the spring of 1990 (Matkin et al. 1994). Two other

carcasses of killer whales were found in Prince William Sound in 1990, and one was found in 1992. Two of those three were confirmed as transients based on marine mammal parts found in their stomach (Matkin et al. 1994). A fifth killer whale carcass was found on Kayak Island 60 miles southeast of the sound, also with marine mammal parts in its stomach (date not reported) (Matkin et al. 1993). No other killer whale carcasses were found in the Prince William Sound region from 1983 through 1992 (Matkin et al. 1994). In addition, no strandings of killer whales were reported from Prince William Sound from 1975 to 1987 (Zimmerman 1991). In sum, these facts lead to the conclusion that the 11 whales missing since 1991 should be presumed dead, though only one whale was documented to have died.

In the AT1 group, all 11 individuals confirmed as alive after 1989 were seen nearly every year from 1990-92 (Matkin et al. 1994). The number of individuals seen in subsequent years was 8 in 1993, 5 in 1994, 11 in 1995, 9 in 1996, 6 in 1997, 8 in 1998, and 7 in 1999 (Matkin et al. 2000). Since 1993, only in 1995 was every individual whale seen in every year. However, when considering pairs of years, all 11 individuals were seen again in 1996-97, and all 11 individuals were seen again in 1998-99. Therefore, it can be concluded that no mortalities occurred between 1992 and 1998.

Using more current unpublished information, no births have occurred since 1999, and three additional individuals have not been seen in recent years. Therefore, the population size as of the summer of 2004 is thought to be eight whales (C. Matkin, North Gulf Oceanic Society, pers. comm.).

### **Minimum Population Estimate**

The abundance estimate of killer whales is a direct count of individually identifiable animals. Only 11 whales were seen between 1990-1999. Since then, 3 of those whales have not been seen in recent years, so the minimum population estimate is 8 whales. Fourteen years of annual effort have failed to discover any whales that had not been seen previously, so there is no reason to believe there are additional whales in the population. Therefore, this minimum population estimate may be the total population size.

### **Current Population Trend**

The population counts have declined from a level of 22 whales in 1989 to 8 whales in 2004, a decline of 64%. The bulk of the decline apparently occurred in 1989-90.

### **CURRENT AND MAXIMUM NET PRODUCTIVITY RATES**

A reliable estimate of the maximum net productivity rate is currently unavailable for this stock of killer whales. Studies of 'resident' killer whale pods in the Pacific Northwest resulted in estimated population growth rates of 2.92% and 2.54% over the period from 1973 to 1987 (Olesiuk et al. 1990, Brault and Caswell 1993). Until additional stock-specific data become available, it is recommended that the cetacean maximum theoretical net productivity rate ( $R_{MAX}$ ) of 4% be employed for this stock (Wade and Angliss 1997).

### **POTENTIAL BIOLOGICAL REMOVAL**

Under the 1994 reauthorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor:  $PBR = N_{min} \times 0.5R_{Max} \times F_R$ . The recovery factor ( $F_R$ ) for this stock is 0.5, the value for cetacean stocks with unknown population status (Wade and Angliss 1997). Thus, for the AT1 killer whale stock,  $PBR = 0$  animals ( $8 \times 0.02 \times 0.5$ ).

### **HUMAN-CAUSED MORTALITY AND SERIOUS INJURY**

#### **Fisheries Information**

The known range of the AT1 stock is limited to waters of Prince William Sound and Kenai Fjords. There are no federally managed commercial fisheries in this area. State managed commercial fisheries prosecuted within the range of this stock, such as the Prince William Sound salmon set and drift gillnet fisheries, and various herring fisheries, are not known to incur incidental serious injuries or mortalities of AT1 killer whales.

#### **Subsistence/Native Harvest Information**

There are no reports of a subsistence harvest of killer whales in Alaska or Canada.

### Other Mortality

Collisions with boats may be an occasional source of mortality. One mortality due to a ship strike occurred in 1998, when a killer whale struck the propeller of a vessel in the Bering Sea groundfish trawl fishery. There have been no known mortalities of AT1 killer whales due to ship strikes.

### STATUS OF STOCK

The AT1 transient stock of killer whales was designated as “depleted” under the MMPA. Therefore, the AT1 transient stock of killer whales is classified as a strategic stock. At least 11 animals were alive in 1998, but it appears that as of 2004, only 8 individuals may be alive. Therefore, the AT1 group has been reduced to at least 50% (11/22) of its 1984 level, and has likely been reduced to 36% (8/22) of its 1984 level. The AT1 transient stock of killer whales is not listed as “threatened” or “endangered” under the Endangered Species Act.

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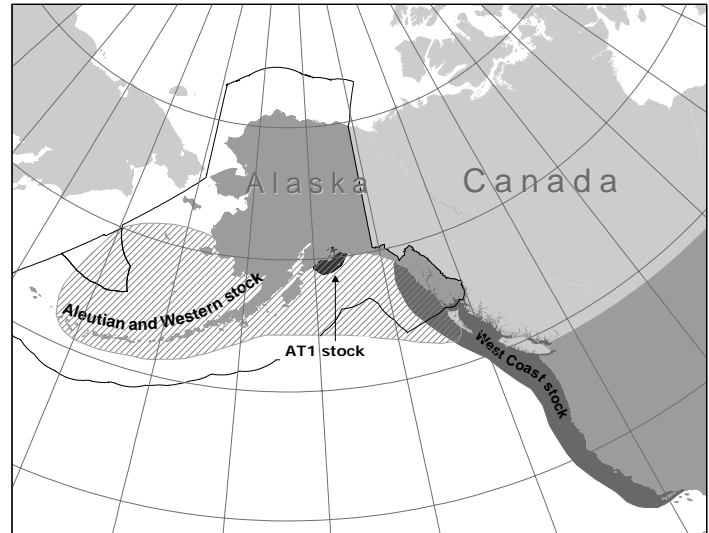
**KILLER WHALE (*Orcinus orca*):  
West Coast Transient stock**

**STOCK DEFINITION AND GEOGRAPHIC RANGE**

Killer whales have been observed in all oceans and seas of the world (Leatherwood and Dahlheim 1978). Although reported from tropical and offshore waters, killer whales occur at higher densities in colder and more productive waters of both hemispheres, with the greatest densities found at high latitudes (Mitchell 1975, Leatherwood and Dahlheim, 1978, and Forney and Wade in press). Killer whales are found throughout the North Pacific. Along the west coast of North America, killer whales occur along the entire Alaskan coast (Braham and Dahlheim 1982), in British Columbia and Washington inland waterways (Bigg et al. 1990), and along the outer coasts of Washington, Oregon, and California (Green et al. 1992; Barlow 1995, 1997; Forney et al. 1995). Seasonal and year-round occurrence has been noted for killer whales throughout Alaska (Braham and Dahlheim 1982) and in the intracoastal waterways of British Columbia and Washington State, where pods have been labeled as 'resident,' 'transient,' and 'offshore' (Bigg et al. 1990, Ford et al. 2000) based on aspects of morphology, ecology, genetics, and behavior (Ford and Fisher 1982, Baird and Stacey 1988, Baird et al. 1992, Hoelzel et al. 1998, 2002, Barrett-Lennard 2000). Through examination of photographs of recognizable individuals and pods, movements of whales between geographical areas have been documented. For example, whales identified in Prince William Sound have been observed near Kodiak Island (Matkin et al. 1999) and whales identified in Southeast Alaska have been observed in Prince William Sound, British Columbia, and Puget Sound (Leatherwood et al. 1990, Dahlheim et al. 1997). Movements of killer whales between the waters of Southeast Alaska and central California have also been documented (Goley and Straley 1994).

Several studies provide evidence that the 'resident', 'offshore', and 'transient' ecotypes are genetically distinct in both mtDNA and nuclear DNA (Hoelzel and Dover 1991; Hoelzel et al. 1998, 2002; Barrett-Lennard 2000). Genetic differences have also been found between populations within the 'transient' and 'resident' ecotypes (Hoelzel et al. 1998, 2002; Barrett-Lennard 2000).

Until recently, transient killer whales in Alaska had only been studied intensively in southeastern Alaska and in the Gulf of Alaska (from Prince William Sound, through the Kenai Fjords, and around Kodiak Island). In the Gulf of Alaska, Matkin et al. (1999) described two communities of transients which were never found in association with one another, the so-called 'Gulf of Alaska' transients and 'AT1' transients. Neither of these communities associates with transient killer whales that range from California to southeastern Alaska, which has been termed the 'west coast' stock. 'Gulf of Alaska' transients are seen throughout the Gulf of Alaska, including occasional sightings in Prince William Sound. AT1 transients are primarily seen in Prince William Sound and in the Kenai Fjords region, and are therefore partially sympatric with 'Gulf of Alaska' transients. Transients that associate with the 'Gulf of Alaska' community have been found to have two mtDNA haplotypes, neither of which is found in the west coast or AT1 communities. Members of the AT1 community share a single mtDNA haplotype. Transient killer whales from the 'west coast' community have been found to share a single mtDNA haplotype that is not found in the other communities. Additionally, all three communities have been found to have significant differences in nuclear (microsatellite) DNA (Barrett-Lennard 2000). Acoustic differences have been found, as well, as Saulitis (1993) described acoustic differences between 'Gulf of Alaska' transients and AT1 transients. For these reasons, the 'Gulf of



**Figure 2125.** Approximate distribution of killer whales in the eastern North Pacific (shaded area). The distribution of the eastern North Pacific Resident and Transient stocks are largely overlapping (see text).



Alaska' transients are considered part of a population that is discrete from the AT1 population, and both of these communities are considered discrete from the 'west coast' transients.

Recent research in western Alaska, particularly along the south side of the Alaska Peninsula and in the eastern Aleutian Islands, have identified transient killer whales that share acoustic calls and mtDNA haplotypes with the Gulf of Alaska transients (NMML unpublished, NGOS unpublished), suggesting transient whales there may be part of the same population as Gulf of Alaska transients. On the other hand, samples from the central Aleutian Islands and Bering Sea have identified mtDNA haplotypes not found in Gulf of Alaska transients, suggesting the possibility there is some population structure in western Alaska. At this point, there is insufficient data to resolve transient population structure in western Alaska any further. Therefore, transient-type killer whales from the Aleutian Islands and Bering Sea are considered to be part of a single population that includes 'Gulf of Alaska' transients. Killer whales are seen in the northern Bering Sea and Beaufort Sea, but little is known about these whales.

In summary, within the transient ecotype, association data (Ford et al. 1994, Ford and Ellis 1999, Matkin et al. 1999), acoustic data (Saulitis 1993, Ford and Ellis 1999) and genetic data (Hoelzel et al. 1998, 2002; Barrett-Lennard 2000) confirms that three communities of transient whales exist and represent three discrete populations: 1) Gulf of Alaska, Aleutian Islands, and Bering Sea transients, 2) AT1 transients, and 3) West Coast transients.

Based on data regarding association patterns, movements, acoustics, genetic differences and potential fishery interactions, eight killer whale stocks are recognized within the Pacific U.S. EEZ: 1) the Alaska Resident stock - occurring from southeastern Alaska to the Aleutian Islands and Bering Sea, 2) the Northern Resident stock - occurring from British Columbia through part of southeastern Alaska, 3) the Southern Resident stock - occurring mainly within the inland waters of Washington State and southern British Columbia, but also in coastal waters from British Columbia through California, 4) the Gulf of Alaska, Aleutian Islands, and Bering Sea Transient stock - occurring mainly from Prince William Sound through the Aleutian Islands and Bering Sea (see Fig. 2425), 5) the AT1 transient stock - occurring in Alaska from Prince William Sound through the Kenai Fjords, 6) the West Coast transient stock - occurring from California through southeastern Alaska, 7) the Offshore stock - occurring from California through Alaska, and 8) the Hawaiian stock. 'Transient' whales in Canadian waters are considered part of the West Coast Transient stock. The Stock Assessment Reports for the Alaska Region contain information concerning all the killer whale stocks except the Hawaiian and Offshore stocks.

The West Coast Transient Stock includes animals that occur in California, Oregon, Washington, British Columbia and southeastern Alaska. On many occasions, transient whales from the inland waters of southeastern Alaska have been seen in association with British Columbia/Washington State transients. On other occasions, some of those same British Columbia whales have been sighted with whales more frequently seen off California thus linking these whales by association.

## **POPULATION SIZE**

The West Coast Transient stock is a trans-boundary stock, including killer whales from British Columbia. Preliminary analysis of photographic data resulted in the following minimum counts for 'transient' killer whales belonging to the West Coast Transient stock (Note: individual whales have been matched between geographical regions and missing animals likely to be dead have been subtracted). In British Columbia and southeastern Alaska, 219 'transient' whales have been cataloged (Ford and Ellis 1999). Off the coast of California, 105 'transient' whales have been identified (Black et al. 1997): 10 whales were matched to photos of 'transients' in other catalogs and the remaining 95 were linked by association. An additional 14 whales in southeastern Alaska (M. Dahlheim, unpubl. data) and 16 whales off the coast of California (N. Black, pers. comm.) have been provisionally classified as 'transient' whales by association. Combining the counts of cataloged 'transient' whales gives a minimum number of 314 (219 + 95) killer whales belonging to the West Coast Transient stock.

## **Minimum Population Estimate**

The abundance estimate of killer whales is a direct count of individually identifiable animals. However, the number of cataloged whales does not necessarily represent the number of live animals. Some animals may have died, but whales can not be presumed dead if not resighted because long periods of time between sightings are common for some 'transient' animals. On the other hand, given that researchers continue to identify new whales, the estimate of abundance based on the number of uniquely identified individuals cataloged is likely conservative. However, the rate of discovering new whales within southeastern Alaska is relatively low. In addition, the abundance estimate does not include 14 whales from southeastern Alaska and 16 whales off the coast of California that have been provisionally classified as 'transients'.



Other estimates of the overall population size (i.e.,  $N_{\text{BEST}}$ ) and associated  $CV(N)$  are not currently available. Thus, the minimum population estimate ( $N_{\text{MIN}}$ ) for the Eastern North Pacific Transient stock of killer whales is 314 animals, which includes animals found in Canadian waters (see PBR Guidelines regarding the status of migratory trans-boundary stocks, Wade and Angliss 1997). Information on the percentage of time animals typically encountered in Canadian waters spend in U.S. waters is unknown. However, as noted above, this minimum population estimate is considered conservative. This approach is consistent with previous recommendations of the Alaska Scientific Review Group (DeMaster 1996).

### **Current Population Trend**

At present, reliable data on trends in population abundance for the West Coast Transient stock of killer whales are unavailable.

### **CURRENT AND MAXIMUM NET PRODUCTIVITY RATES**

A reliable estimate of the maximum net productivity rate is currently unavailable for this stock of killer whales. Studies of ‘resident’ killer whale pods in the Pacific Northwest resulted in estimated population growth rates of 2.92% and 2.54% over the period from 1973 to 1987 (Olesiuk et al. 1990, Brault and Caswell 1993). However, a population increases at the maximum growth rate ( $R_{\text{MAX}}$ ) only when the population is at extremely low levels; thus, the estimate of 2.92% is not a reliable estimate of  $R_{\text{MAX}}$ . Hence, until additional data become available, it is recommended that the cetacean maximum theoretical net productivity rate ( $R_{\text{MAX}}$ ) of 4% be employed for this stock (Wade and Angliss 1997).

### **POTENTIAL BIOLOGICAL REMOVAL**

Under the 1994 reauthorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor:  $PBR = N_{\text{min}} \times 0.5R_{\text{MAX}} \times F_R$ . The recovery factor ( $F_R$ ) for this stock is 0.5, the value for cetacean stocks with unknown population status with a mortality rate  $CV \geq 0.80$  (Wade and Angliss 1997). Thus, for the Eastern North Pacific Transient killer whale stock,  $PBR = 3.1$  animals ( $314 \times 0.02 \times 0.5$ ). The proportion of time that this trans-boundary stock spends in Canadian waters cannot be determined (G. Ellis, Pacific Biological Station, Canada, pers. comm.)

### **HUMAN-CAUSED MORTALITY AND SERIOUS INJURY**

#### **Fisheries Information**

NMFS observers monitored the California/Oregon thresher shark/swordfish drift gillnet fishery from 1994 to 2003 (Table 19; Julian 1997, Julian and Beeson 1998, Cameron and Forney 1999, Carretta 2002, Carretta and Chivers 2003, Carretta and Chivers 2004). The observed mortality in this fishery, in 1995, was a transient whale as determined by genetic testing (S. Chivers, NMFS-SWFSC, pers. comm.). Overall entanglement rates in the California/Oregon thresher shark/swordfish drift gillnet fishery dropped considerably after the 1997 implementation of a Take Reduction Plan, which included skipper education workshops and required the use of pingers and minimum 6-fathom extenders (Barlow and Cameron 1999). Because the California/Oregon thresher shark/swordfish drift gillnet fishery is observed and has not incurred incidental serious injuries or mortalities of killer whales between 1999-2003, the estimate of fishery-related take for this fishery is zero. ~~Because of the changes in this fishery after implementation of the Take Reduction Plan, mean annual takes in Table 19 are based only on 1997-98 data.~~ Thus, the mean annual mortality rate for this stock is zero. Additional fisheries that could interact with the Eastern North Pacific Transient stock of killer whales are listed in Appendix 3.

An additional source of information on the number of killer whales killed or injured incidental to commercial fishery operations is the self-reported fisheries information required of vessel operators by the MMPA. During the period between 1994 and 2003, there were no fisher self-reports of killer whale mortalities from any fisheries operating within the range of this stock. However, because logbook records (fisher self-reports required during 1990-94) are most likely negatively biased (Credle et al. 1994), these are considered to be minimum estimates. Self-reported fisheries data are incomplete for 1994, not available for 1995, and considered unreliable after 1995 (see Appendix 7 for details.)

The estimated minimum mortality rate incidental to recently monitored U.S. commercial fisheries is zero animals per year.

**Table 1932.** Summary of incidental mortality of killer whales (Eastern North Pacific Transient stock) due to commercial fisheries and calculation of the mean annual mortality rate. Mean annual takes are based on 1994-98 data unless noted otherwise.

Fishery name	Years	Data type	Percent observer coverage	Observed mortality	Estimated mortality	Mean annual takes (CV in parentheses)
CA/OR thresher shark/swordfish drift gillnet UPDATE	94-03	obs data	12-23%	0, 1, 0, 0, 0	0, 6, 0, 0, 0	0*
Estimated total annual takes						0.6 (1.0)

\* Only 1997-98 mortality estimates are included in the average because of gear modifications implemented within the fishery as part of a 1997 Take Reduction Plan. Gear modifications included the use of net extenders and acoustic warning devices (pingers).

Due to a lack of Canadian observer programs, there are few data concerning the mortality of marine mammals incidental to Canadian commercial fisheries, which are analogous to U.S. fisheries that are known to interact with killer whales. The sablefish longline fishery accounts for a large proportion of the commercial fishing/killer whale interactions in Alaska waters. Such interactions have not been reported in Canadian waters where sablefish are taken via a pot fishery. Since 1990, there have been no reported fishery-related strandings of killer whales in Canadian waters. However, in 1994, one killer whale was reported to have contacted a salmon gillnet, but it did not entangle (Guenther et al. 1995). Data regarding the level of killer whale mortality related to commercial fisheries in Canadian waters, though thought to be small, are not readily available or reliable which results in an underestimate of the annual mortality for this stock.

#### Subsistence/Native Harvest Information

There are no reports of a subsistence harvest of killer whales in Alaska or Canada.

#### Other Mortality

The shooting of killer whales in Canadian waters has been a concern in the past. However, in recent years there have been no reports of shooting incidents in Canadian waters. In fact, the likelihood of shooting incidents involving 'transient' killer whales is thought to be minimal since commercial fishermen are most likely to observe 'transients' feeding on seals or sea lions instead of interacting with their fishing gear (G. Ellis, Pacific Biological Station, Canada, pers. comm.).

Collisions with boats are another source of mortality. One mortality due to a ship strike occurred in 1998, when a killer whale struck the propeller of a vessel in the Bering Sea groundfish trawl fishery. There have been no reported mortalities of killer whales from this stock due to ship strikes.

#### STATUS OF STOCK

The West Coast transient killer whale stock is not designated as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. Recall that the human-caused mortality has been underestimated, primarily due to a lack of information on Canadian fisheries, and that the minimum abundance estimate is considered conservative (because researchers continue to encounter new whales and provisionally classified whales from southeastern Alaska and off the coast of California were not included), resulting in a conservative PBR estimate. Based on currently available data, the estimated annual fishery-related mortality level (0.0) does not exceed 10% of the PBR (0.3) and, therefore, can be considered to be insignificant and approaching zero mortality and serious injury rate. The estimated annual level of human-caused mortality and serious injury (0.0 animals per year) does not exceed the PBR (3.1). Therefore, the West Coast Transient stock of killer whales is not classified as a strategic stock. Population trends and status of this stock relative to its Optimum Sustainable Population (OSP) level are currently unknown.

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